# Department of Trade & Industry
# Policy Support Programme

## Investment Study (code: A.1.003)
## Project A (code: 2A)

# DETERMINANTS OF INVESTMENT IN SOUTH AFRICA: A SECTORAL APPROACH

**March 2000**

**Submitted by the**
**Trade and Industrial Policy Secretariat (TIPS)**


**AGORA' 2000 S.r.l**
**Management Consultants**
**Via Germanico, 172**
**I-00192 Rome – ITALY**
**Tel: +(39) 063 241-719 - +(39) 063 216 915**

**DRA – Development cc**
**Development Researchers & Policy Analysts**
**59 Rosebank Avenue, Roseglen, Morningside**
**Durban 4001 – SOUTH AFRICA**
**Tel +(27-31) 208-4112 - +(27-31) 208 8437**

**Department of Trade & Industry Policy Support Programme**
**Programme Management Unit**


**Abstract**

Low investment levels in the South African economy are consistently identified as the principal factor behind suboptimal growth rates. Despite the increasing recognition of the importance of investment there is relatively little analytical research available in South Africa on the determinants of investment behaviour, specifically at the sectoral level.

It is therefore of primary importance that empirically based research should attempt to examine those variables that may influence investment spending. Economic theory identifies these variables but empirical research can be used to determine the extent to which microeconomic and macroeconomic variables affect investment behaviour. In addition, variables overlooked in past studies in the South African literature such as uncertainty and instability should be included in any empirical research. This is particularly important given the current evidence that indicates these variables have a considerable influence on investment in the developing world, including South Africa. This report describes the results of an EU funded research project that focuses on the determinants of investment in South African manufacturing based on time series analysis at the sectoral level. The report contains 7 sections.

**Section 1** is intended to give a brief overview of the main thrust of investments trends in the various sectors of the South African economy, as well as an introduction of some of the important factors that influence investment. The main contributor to this section is Rashad Cassim of TIPS.

**Section 2** is aimed at those who want more detail on the theory of the determinants of investment and earlier empirical research. It is not intended for those readers who want to get to the key findings of this preliminary report. The section suggests that ample work needs to be done in examining investment in South Africa so that investment behaviour in the country is better understood. Of primary importance, empirically based research should attempt to examine the variables that influence investment spending. By undertaking such research, public policy which intends to encourage or attract investment in South Africa can be better designed and implemented. The main contributor to this section is Troy Elyea of TIPS.

**Section 3** presents a broad discussion of the data used. A number of variables employed in the later parts of the report, are reviewed in terms of their sources and dimensions. The discussion covers data on output, employment, capital stock and trade. A special subsection is devoted to the sources of a political instability index. The main contributor to this section is Dirk Ernst van Seventer of TIPS.

**Section 4** consist of the detailed descriptive analysis of the sectoral variations in investment. From the analysis in this section it is clear that more than just a descriptive analysis is required in order to get a clear picture of the determinants of investment in South Africa.. Nevertheless descriptive analysis is a necessary step towards more detailed time series analysis in order to check for consistencies in the data series and possible outliers.

In general the data suggest that there is likely to be a number of different determinants of investment in South African manufacturing. Since we know investment expenditure to have a multivariate explanation, and ceteris is not paribus in the current context, the varied results of the descriptive analysis are perhaps not entirely surprising. Nevertheless, the exploratory analysis does lend credence to the presence of long run patterns of structural change in South African capital markets – played out over the full 1970-97 time frame. Moreover the 1990's mark a structural break, with the sudden emergence into prominence of (some) manufacturing sectors as leading investors, and the possibility that distortions to capital markets may have diminished over time, leading to a greater reliance on market forces.

The descriptive analysis also suggests that where economic sectors are allowed to respond to market forces, in the sense that factor rewards are more closely linked to factor productivity, investment rates are likely to be more sustainable in the long run. The evidence examined for this section, suggests that for South African capital markets the link between factor rewards and productivity appears to be have been strengthening during the course of the 1990's. This section is compiled by Johannes Fedderke, Simon Henderson, John Kayemba, Martine Mariotti, and Prabhat Vaze, of Econometric Research Southern Africa and drawn from a paper by Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b).

In **Section 5** the report presents estimated investment functions for the period 1970-1997 using panel data for the manufacturing sector as a whole and a limited number of manufacturing clusters. . The results confirm a significant response of investment rates to changes in capacity utilisation, In additiona it is found that uncertainty appears to impact on investment rates in the manufacturing sector. In particular, systemic uncertainty (as proxied by an index of political instability) lowers investment rates in manufacturing industry. Furthermore, the real user cost of capital is found to be statistically significant as a determinant of investment rates in South African manufacturing industry. Thus, policy makers play a role in creating the appropriate conditions for rising investment rates through an alteration of the real user cost of capital.

The report also finds that credit rationing appears not to have played a role in the formal manufacturing sectors, although it may of course be a significant factor in the informal sector not included in the sample on which our data is based. Technological change, openness with regard to trade, and changes in the real cost of labour are similarly insignificant as determinants of investment rates. The report suggests that the finding on the negative impact of the skills ratio in the employment of manufacturing sectors is consistent with the suggestion that the poorly conceived educational policies of past South African governments may have enhanced a reliance on increased capital intensity of production. The rate of return on capital stock appears to add information on the expected payoff to investment expenditure over and above the capacity utilisation proxy employed throughout the report.

Most econometric estimations are conducted at the aggregate level for manufacturing as a whole, in order to maximise statistical power. At the level of the individual manufacturing sectors there are not sufficient observations to arrive at solid conclusions. There is, however, some evidence of heterogeneity in the panel under investigation. In order to develop a better understanding of such heterogeneity, the possibility to identify subgroups within the total manufacturing sectors is explored. What emerges from the clusters of manufacturing sector estimations is evidence of some strong sectoral differences. Of the three groupings of manufacturing sectors Wage Goods sectors are the most responsive to changing demand factors. Moreover, only the Fabricated Goods sectors shows a statistically significant response to changes in the user cost of capital. Finally, all three groupings are sensitive to uncertainty. The Resource Intensive sectors prove to be not only the most sensitive to the impact of uncertainty, but uncertainty seems to dominate all other determinants of the investment rate. Finally, the report notes that the adjustment to equilibrium is of differential speed between the three clusters, with the Wage Goods sectors responding most slowly and the Resource Intensive sectors most quickly to policy interventions. This section is compiled by Johannes Fedderke of Econometric Research Southern Africa and drawn from a paper by Fedderke (2000).

**Section 6** focuses on foreign direct investment (FDI). The aim is not to review a lengthy debate, rather the objective is more modest in that an attempt is made to link the determinants of domestic investment and foreign direct investment in South Africa. Albeit far from comprehensive the section notes that during the 1990s FDI has seen strong growth in South Africa. However, a comparison with actual observed gross domestic fixed investment is not readily available due to definitional differences between the two concepts. Notably, it is unclear from the data sources whether FDI proceeds from an intention recorded in the media to actual foreign capital inflow and if so whether the capital inflow is not just financing a change in asset ownership in stead of a greenfield investment.

It is argued in the section that most FDI is aimed at the services sector and follows recent privatisation initiatives, some of which have been tied to actual capital expenditure. Apart from these particular circumstances in recent South African history, the section notes that international evidence suggests a close relationship between domestic investment and FDI with the added dimensions of exchange rate volatility and political instability. This section is compiled by Rashad Cassim of TIPS and is mainly drawn from a paper by Karen Heese (1999)

**Section 7** concludes while **section 8** draws tentative policy conclusions and offers recommendations for further research. The empirical findings at the macro sectoral level and at the level of the sector clusters carry with them some important policy implications.

- Uncertainty matters for investment, and it does so across all manufacturing sectors in the South African economy. This conclusion is maintained if we control for various definitions of uncertainty. The evidence presented in this report consistently affirms the importance of uncertainty in lowering the investment rate in South African manufacturing. Moreover, uncertainty raises the threshold rate of return below which investment is unlikely to occur. Lowering uncertainty carries both a direct positive stimulus to investment, and it serves to render other policy levers more effective in achieving their objective.

- Since changes in the real user cost of capital influences the investment rate of manufacturing sectors, changes in the component cost elements that governments can influence will also carry with them long run changes in investment rates.
- Changing demand conditions, proxying for the expected payoff to investment activity, are seen to impact on investment rates. Such an impact is found to be strongest on Wage Goods, while evidence of a demand impact on Resource Intensive and Fabricated Goods sectors is weaker.
- It is important to bear in mind that the effects identified above are long term in nature. Hence the conclusions drawn must constantly be modulated by the realisation that adjustment to new equilibrium investment rates after any policy intervention will not be instantaneous, but subject to a dynamic adjustment path.
- Trade does not appear to exert a negative influence on investment rates. Thus openness of the economy is unlikely to be a deterrent to healthy investment rates.
- The impact of higher skills ratios on investment rates should be seen in the context of South Africa's weak track record in human capital development. As the severe skills shortages of the South African economy come to be ameliorated, such an impact may change from that found for the 1970-97 period.

## Table of Contents

## List of Tables

## List of Figures

# Section 1: Introduction: Broad Trends in Investment in South Africa

### *1.1) Introduction*

Low investment levels in the South African economy are consistently identified as the principal factor behind suboptimal growth rates. Despite the increasing recognition of the importance of investment there is relatively little analytical research available in South Africa on the determinants of investment behaviour, specifically at the sectoral level.

It is therefore of primary importance that empirically based research should attempt to examine the variables that influence investment spending. Economic theory identifies these variables but empirical research can be used to determine the extent to which microeconomic and macroeconomic variables affect investment behaviour. In addition, variables overlooked in past studies in the South African literature such as uncertainty and instability should be included in any empirical research. This is particularly important given the current evidence that indicates these variables have a considerable influence on investment in the developing world, including South Africa.

The aim of this report is to make a contribution to the understanding of sectoral trends in investment in South Africa. There is a long history of the study of the determinants of investment behaviour. A number of these determinants have been advanced on the basis of economic theory, but it is equally important that empirical research be used in order to determine the extent to which each determinant affects investment behaviour. In addition, variables overlooked in past studies in the South African literature such as uncertainty and instability should be included in any empirical research. This is particularly important given the current evidence that indicates that these variables may have a considerable influence on investment in the developing world, including South Africa. This report uses recently compiled economy-wide data that covers the period of 1970-1997 for a range of economic variables and a number of production activities. The report should be seen as providing a top down overview of sectoral investment behaviour in South Africa and complements more sector specific studies that employ survey techniques. Given the time dimension present in the sectoral data, it is also feasible to establish the nature of long run equilibrium relationships between the determinants of investment expenditure and investment rates by sector, which is precluded by cross sectional studies.

Organisation of the report is as follows. After an introduction to some broad investment trends in South Africa in the current section, we will start our report in Section 2 with an overview of some theoretical perspectives on investment behaviour and a scan of the international and South African literature. This is followed by a description of the data set used in the report in Section 3. The fourth Section consists of a somewhat detailed descriptive analysis of investment patterns based on a broad range of economic variables for each of the identified sectors. Section 5 of the report will attempt to provide a more specific analysis of differential sectoral investment trends using econometric analysis based on heterogeneous panel data. The aim of this section is to offer explanations as to the determinants of investment at the sectoral level in South Africa. Since historical trends on foreign direct investment are not available in the same format as the trends on total investment, an

independent Section 6 is devoted to foreign direct investment. We conclude with a summary in Section 7 and and policy recommendations in Section 8.

### *1.2) Broad Trends*

Research has shown that increasing investment in it itself is less important for sustainable growth than is the quality, type and composition of investment. The key question facing South Africa is what types of investment will induce the highest growth in the economy. As we can see from Table 1.1 below, average private investment in the 1980s was much higher than that in the 1990s but this did not appear to make a fundamental difference to growth. An average investment to GDP ratio of 18.5% induced average annual growth of 1.6% during the 1980s while an investment ratio of 14.5% is associated with growth of 1.1% during the 1990s.

Table 1.1: Growth and Investment in South Africa

| | 1971-80 | 1981-90 | 1991-98 |
|---|---|---|---|
| Real Growth Rates | 3.9 | 1.6 | 1.1 |
| Average Private Investment to GDP Ratio | 19.3 | 18.5 | 14.5 |

*Source: Jenkins, 1999, SARB data*

More specifically, at the sectoral level Table 1.2 shows a cluster of sectors that have experienced over 5% real average annual growth rates in gross domestic fixed investment (GDFI) during the first 7 years of the 1990s. High growth rates of over 30% for some sectors such as printing, glass and transport equipment (other than motor vehicles, parts and accessories) have been recorded. Sectors such as furniture, television, basic chemical, paper products, non-ferrous metals and food have also experienced significant growth rates in GDFI.

Table 1.2: Gross Domestic Fixed Investment Average Annual Growth Rates, Sectors with High Growth Rates (larger than 5%) for the Period 1990 to 1997(at 1990 constant prices)

| | SIC (5th ed) | Sector | GDFI growth rate |
|---|---|---|---|
| 1. | 324-326 | Printing, publishing & recorded media | 32.2% |
| 2. | 341 | Glass & glass products | 30.8% |
| 3. | 384-387 | Other transport equipment | 30.0% |
| 4. | 391 | Furniture | 23.9% |
| 5. | 371-373 | Television, radio & communication equipment | 23.2% |
| 6. | 351 | Basic iron & steel | 17.9% |
| 7. | 334 | Basic chemicals | 16.1% |
| 8. | 323 | Paper & paper products | 16.1% |
| 9. | 352 | Basic non-ferrous metals | 15.9% |
| 10. | 301-304 | Food | 11.6% |
| 11. | 342 | Non-metallic minerals | 10.6% |
| 12. | 338 | Plastic products | 6.9% |
| 13. | 61-63 | Wholesale & retail trade | 6.8% |
| 14. | 311-312 | Textiles | 5.4% |
| 15. | 41-42 | Electricity, gas & steam | 5.1% |

*Source: own calculations*

Table 1.3 presents a list of sectors with moderate growth rates for the same period while Table 1.4 list sectors with low or negative growth. Sectors with moderate growth rates are amongst others rubber products, finance, metals. Sectors with negative growth rates, on the other hand, are machinery and equipment, footwear and beverages.

Table 1.3: Gross Domestic Fixed Investment Average Annual Growth Rates, Sectors with Moderate Growth Rates for the Period 1990 to 1997 (1990 constant prices)

| | SIC (5th ed) | Sector | GDFI growth rate |
|---|---|---|---|
| 1. | 337 | Rubber products | 3.3% |
| 2. | 81-83 | Finance & insurance | 3.0% |
| 3. | 11-13 | Agriculture, forestry & fishing | 3.0% |
| 4. | 71-72 | Transport & storage | 2.0% |
| 5. | 321-322 | Wood & wood products | 1.9% |
| 6. | 353-355 | Metal products excluding machinery | 1.4% |
| 7. | 335-336 | Other chemicals & man-made fibres | 1.3% |
| 8. | 23 | Gold & uranium ore mining | 1.2% |
| 9. | 316 | Leather & leather products | 0.4% |

*Source: own calculations*

Table 1.4: Average Annual Growth Rates, Sectors with No or Negative Growth Rates for the Period 1990 to 1997(1990 constant prices)

| | SIC (5th ed) | Sector | GDFI growth rate |
|---|---|---|---|
| 1. | 374-376 | Professional & scientific equipment | 0.0% |
| 2. | 361-366 | Electrical machinery | 0.0% |
| 3. | 356-359 | Machinery & equipment | -0.1% |
| 4. | 313-315 | Wearing apparel | -1.3% |
| 5. | 51-53 | Building construction | -2.0% |
| 6. | 93-99 | Community services | -3.8% |
| 7. | 381-383 | Motor vehicles, parts & accessories | -4.0% |
| 8. | 22, 24, 25, 29 | Other mining | -4.9% |
| 9. | 317 | Footwear | -7.2% |
| 10. | 305 | Beverages | -7.3% |
| 11. | 21 | Coal mining | -9.1% |
| 12. | 331-333 | Coke & refined petroleum products | -10.7% |
| 13. | 306 | Tobacco | -22.2% |
| 14. | 392 | Other industries | -42.4% |

*Source: own calculations*

From the data presented in the Tables 1.2-1.4 no clear sectoral patterns are visible. The variation in growth rates of gross domestic fixed investment does not identify specific sectoral groupings, such as the chemicals cluster, wage goods, tradeable, non-tradeables, or resource based industries, that manifest group-characteristic investment patterns. This suggests that further analysis is required to distil more relevant information out of the available data bases. Before doing so, we briefly review some theoretical aspects of the determinants of investment behaviour.

There is a voluminous literature on investment that attempts to quantify and prioritise the key determinants of investment behaviour. Although, the determinants of investment will depend on country specificities, there is almost universal consensus on some of the important factors that determine investment. Below, we briefly review a select number of those factors, while a more elaborate exposition on this topic can be found in the next section

***1.3) Rates of Return***

The rate of return is the most obvious factor in influencing investment. Firms invest where they receive the highest rate of return. However, there are two factors that cloud this measure. Firstly, a range of complex issues account for a specific rate of return. Profitability will depend on wage costs, the cost of capital and other variables. Secondly, as new international literature shows, this may be complicated by factors such as political uncertainty which may discourage investors despite a high rate of return.

***1.4) Uncertainty***

The principal mechanism through which political and policy uncertainty influences investment is the perception amongst investors that future events (such as a reversal in trade policy) could make current profitable ventures less profitable later on. Factors that create uncertainty, in terms of expected costs or retums, will delay investment until there is a favourable climate change that is expected to remain stable over the foreseeable future. A great deal of current theoretical and empirical work on investment aims to develop acceptable measures of uncertainty. Some of these measures will be employed in this report.

***1.5) User Cost of Capital***

Measurements of the cost of capital can get very complex and technical but there is general agreement that the core factors that influence the cost of capital are real interest rates, depreciation rates and corporate tax rates. Both theory and empirical evidence suggests that there is a negative relationship between real interest rates and investment. This is because a higher real interest rate causes borrowing of capital to be more costly, thus discouraging investment. In addition, institutional factors such as the nature of financial intermediation in countries can influence allocation of investment by creating differential prices for the user cost of capital.

***1.6) Demand***

Following the accelerator principle, a potentially important factor in investment behaviour is the level of demand which can be measured by output growth and/or capacity utilisation. The latter can also be seen as a measure of expected rate of return. With a given level of potential output, an increase in demand will result in higher levels of capacity utilisation. It is likely that an entrepreneur, faced with higher level of capacity utilisation will then decide to undertake investment in order to avoid potential bottlenecks and reap benefits of economies of scale.

***1.7) Infrastructural Investment***

A considerable body of literature has accumulated over the years, which shows that public sector investment in infrastructure, possibly in collaboration with the private sector, can have a significant positive impact on private sector investment. There are several reason for this to occur. Where previously none existed, the provision of economic infrastructure such as a road may increase capital productivity or reduce production costs. In both cases, profitability could increase, leading to private sector investment. In other cases, the provision of infrastructure, may unlock higher economic activity in a particular region, thereby inducing further private sector investment. In the next section we will explore the theoretical perspectives on the determinants of investment behaviour in more detail, including additional modulations such as credit rationing, trade, wage rates and availability of skilled labour.

# Section 2: Determinants of Investment Behaviour: Some Theoretical Perspectives

### *2.1) Introduction*

The determinants of investment in South Africa are poorly understood. Nevertheless, few issues in the economic policy debate of the country enjoys such a wide consensus as the need for increased fixed investment as a means to attain higher economic growth. There is a critical need to create a hospitable economic environment so that levels of fixed investment can increase well above the current rate. A method by which the government has attempted to create an attractive investment climate has been through the introduction and implementation of its Growth, Employment and Redistribution (GEAR) programme. The primary goal of GEAR is to raise growth rates and create jobs by controlling fiscal spending and monetary measures. However, the performance of the South African economy since GEAR's inception has been disappointing. A growth rate of 3.2 % in 1996 was in line with GEAR targets, but growth of only 1.7% in 1997 fell well short of a targeted 3%. The performance during 1998 and 1999 are also well below the projected 4% in GEAR. Behind these growth rates lie poor investment rates, especially foreign direct investment (FDI), which has failed to materialise in the quantities expected.[1] FDI in the last two years was in the region of US$ 3 billion at the current exchange rate.

Despite the recognition of the importance of investment, there is alarmingly little analytical research in South Africa on the determinants of aggregate investment behaviour, and almost no research investigating investment at the sectoral level, especially manufacturing and to a lesser extent services. Some policy work on investment exists in the country but these are both dated and very specific, and fail to address issues of interest to the Department of Trade and Industry (DTI). Most research on investment to date emanates from macro-economists concerned with larger questions about the relationship between interest rates, savings and investment, although even in this area there is a paucity of work.

The objective of this section is to offer a somewhat in-depth analysis of investment from various perspectives. To understand investment behaviour in South Africa it is essential to understand firm-level investment decisions and how this carries over to an aggregated explanation of investment. Therefore, to understand all the potentially important issues concerning investment, an examination of the current literature is essential. Subsection 2.2 examines the literature; both theoretical and empirical, in order to highlight the important investment issues at hand. Subsection 2.3 will focus specifically on those factors that influence a foreigner's decision to invest. Subsection 2.4 will present the theories of the user cost of capital and Tobin's *q*. Section 2.5 proceeds with the literature examining adjustment costs, uncertainty and irreversibility, while the costs of financing will be tackled in subsection 2.6. Subsection 2.7 will present notable baseline investment models that are empirically motivated which will be modified to incorporate advancements in the theoretical literature that have been detailed in the previous sections. Subsection 2.8 will examine the literature that has attempted to

[1] Although it needs to be recognised that international shocks, particularly the Asian financial crisis and the attendant loss of confidence in emerging markets, were at least partially responsible for this underperformance.

explain investment behaviour in South Africa. Finally, subsection 2.9 will summarise the section and conclude with suggested areas for further research.

***2.2) Applied Theoretical and Empirical Issues in Investment Behaviour***

The goal of this subsection is to present the important theoretical and empirical findings within the relevant investment literature as a means to establish a framework that can be used to examine investment trends and performance in South Africa. By presenting a broad but detailed description of firm investment decisions this section will hopefully leave the reader with a better understanding of investment behaviour of the firm.

The broad literature on the determinants of investment details many factors that affect a firm's decision to invest. Broadly included in these are macroeconomic factors, government policies, financial factors, political factors, external factors and others. It is worth noting, however, that there are important differences between the variables that impact distinctly on foreign investment behaviour in contrast to that of domestic investors.

The firm's investment decision is a complicated matter where countless variables are to be considered. However, the expected return on an investment is an obvious factor of critical importance. Aggregate output is a common indicator used to predict the future growth or market potential of a country. At the microeconomic level aggregate output is a helpful measure used in estimating the future profitability of an investment. For instance, if aggregate output is expected to grow in the future the firm will view this as an increase in demand for their own products. As a reaction the firm will have greater expectations of future profitability and, as a result, will have an incentive to increase current investment levels. This mechanism is better illustrated by an actual increase in aggregate output. An increase in aggregate output raises demand and, in turn, raises the marginal product of a given capital stock. This gives firms the incentive to invest given that the market value of existing capital has increased.

Van der Walt and de Wet (1995) argue that terms of all the variables that affect an investment decision, the expected profit is the most important consideration. The authors suggest that rather than improving certain variables, like macroeconomic stability, governments should adopt policies that guarantee profitable investment opportunities exist.

The drawback of this argument is that it is oversimplifying the investment decision, in a sense, recognising the obvious but failing to delve deeper into this complex problem. By basing the investment decision solely on expected profit Van der Walt and de Wet (1995) are suggesting that the investment decision is simply a matter of equating the marginal product of capital with the marginal cost of capital. Jorgenson's user cost of capital and Tobin's *q* are two theories primarily cited as the theoretical foundations of this argument, which are discussed in some more detail below. However, these theoretical models fail to capture the full complexities of the investment decision.

While it is by no means incorrect to suggest that expected profit is important to the investment decision, it is essential to consider other variables in this regard. The obvious complement to expected profit is the cost of

capital (although expected profits already contain an element of user cost of capital). Of all the variables that affect the cost of capital, the real interest rate is arguably the most important. Both theory and empirical evidence suggest that there is a negative relationship between real interest rates and investment. This is because a higher real interest rate causes investment to be more costly, thus requiring an investment project to manifest a higher rate of return before it becomes profitable, and therefore feasible. Inflation also influences the cost of capital, since a higher inflation rate may increase the relative price of capital goods. Therefore, the rate of inflation is also negatively correlated with investment.

Taxes affect investment by either reducing funds available for investment or reducing the returns from an investment. Tax rates also influence the financing method a firm uses when investing. This is dealt with in more detail in the literature that examines the 'pecking order of finance' or 'financing hierarchy' theories, largely cited in the corporate finance literature, but gaining prominence in the investment literature as well. The basis of these theories is that certain methods of financing are found to be less expensive than others because, in part, of the differing tax levels imposed by government on dividends and income, and the ability to deduct interest payments. Therefore, a preferred order of financing methods is created. Other government policies of note that act to influence investment levels, either by working to reduce the cost of capital or increase the returns on a investment include investment tax credits, tax holidays and accelerated depreciation allowances.

The degree to which variables influence the investment decision often depends on whether firms finance their investment internally or externally, using equity (retained earnings) in the case of the former and bank debt or issuing shares for the latter. An important aspect of the pecking order theory is that firms prefer to use internal finance rather than external finance because of the cost advantage of financing internally, largely attributable to the asymmetric information problems associated with external finance. Lenders are risk averse and despite monitoring are unable to determine which borrowers will fail to meet their repayment requirements. This results in a 'lemons premium' that banks will charge on debt issues as a means to recoup monitoring costs and to reduce adverse selection and moral hazard problems. Therefore, financial factors particularly the availability of internal finance, as measured by cash flows, for those firms who do not have access to affordable external finance are important influences on investment.

Directly related to the costs of the different methods of financing is the development of the financial system of the country. It is argued (see Rajan and Zingales, 1998) that a more developed financial system reduces the cost of external finance. This is because in a highly developed financial system, risk is better managed resulting in a reduction of moral hazard, adverse selection and monitoring costs, thereby reducing the cost of external finance. Furthermore, an advanced financial system can better ensure access to new debt or equity to firms reliant on external finance, thus, providing a better allocation of credit in the market. Therefore, a more developed financial system has a positive impact on investment.

The role of domestic savings on domestic investment is subject to debate in the relevant literature. Theoretically, baseline models such as the Solow growth model suggest that there is no correlation between the two variables. In a world of unrestrained capital mobility, savings are invested evenly around the world so that

there are no discrepancies in the marginal product of capital across countries. This implies that a change in domestic savings will have no dramatic effect on investment in that country. However, the findings of Feldstein & Horioka (1980) suggest that there is a strong correlation between domestic rates of savings and investment in a country. This finding, based on OECD country data, was supported by the idea that capital mobility was restricted. Therefore, increases in domestic saving result in higher investment levels in the domestic market. Yet, studies that have used a different sample of countries, such as OECD and non-OECD countries together (Summers, 1985), or developing countries on their own (Vamvakidis & Wacziarg, 1998), find that the relationship between savings and investment is either weak or insignificant.

In the literature examining the relationship between trade and economic growth Levine & Renelt (1992) suggest that investment is a mechanism through which trade affects growth. For example, trade affects investment by opening up the economy to more competition, which results in greater efficiency of outcomes and, in turn, greater and more efficient investment. Given the positive relationship between investment and growth, trade openness that results in an increase in investment also acts to increase economic growth. Furthermore, trade creates profitable opportunities for firms by providing greater access to a larger market.

It has also been argued that because the traded sector, in some countries, is more capital intensive than the non-trade sector reducing trade protection positively impacts investment levels. However, their capital intensity assumption is based on data from the United States, Japan and the United Kingdom and, thus, may not directly apply to the patterns that exist in developing countries such as South Africa. In general, however, it is suggested in the literature that trade policy affects investment by influencing both the return of capital and the cost of capital to the firm.

An issue that has gained considerable attention in the investment literature is the development of theoretical models that include uncertainty, adjustment costs and irreversibility in explaining the firm's decision to invest. These theories build upon those offered by Jorgenson and Tobin, factoring in further considerations that influence firm investment behaviour. The usefulness of these additions is apparent in their ability to include many variables that are clearly influential on the investment decision but have been otherwise ignored or excluded in the previous literature. This is, to some degree, due to the fact that many of these variables are difficult to measure or in some instances only quantifiable by the use of proxies. We will proceed by highlighting the most important variables that have been examined in this area of the investment literature.

The option value of waiting suggests that a firm will put off investing in an uncertain market environment until a more positive assessment can be reached.[2] Factors that create uncertainty, in terms of expected returns or costs, will delay investment until there is a favourable climate change that is expected to remain stable over the foreseeable future. Therefore, when examining the variables that affect the firm's investment decision, it is critical to consider how they relate to the uncertainty issue, whether dealing with the stability of macroeconomic variables, the credibility of policy changes, or stability of the political regime.

[2] Though note that the early literature on the link between uncertainty and investment predicted a positive relationship.

Macroeconomic factors are, indeed, an important influence on firm investment behaviour. However, the instability of macroeconomic variables can be as important as the value of the variable itself. Instability can negatively impact the investment decision by increasing uncertainty. For instance, if the interest rate is highly volatile the value of waiting is increased potentially resulting in investment being deferred. Therefore, the encouragement of interest rate stability along with pursuing low real interest rates is an important means in promoting investment. In terms of inflation, highly volatile inflation rates illustrate the instability in the country's monetary policy and contribute to an increase the volatility of interest rates. This variability of the inflation rate creates uncertainty that acts as an expectational variable to discourage investment. It is worth noting that the appropriate policy environment in this context is subject to two countervailing requirements. On the one hand, low real interest rates may serve to stimulate investment. On the other, high inflation (which may lead to low real interest rates) tends to also be volatile, and thus serve to decrease investment expenditure. This is one of the important reasons why real interest rates should not only be positive, but why at least some authors argue that controlling inflation through appropriate monetary (and hence interest rate) policy is a prerequisite for sustainable long term investment projects and growth. It is a question of *first* stabilising prices through conservative interest rate policy, and then allowing lower real interest rates to stimulate investment.

Another macroeconomic factor that influences investment is the real exchange rate. Fluctuations in the real exchange rate influence investment decisions by affecting the profitability of export-oriented firms and the cost of capital sourced from abroad by domestic firms. Policies intended to fix the exchange rate at unsustainable levels create a macroeconomic imbalance that will require adjustment in the future. This increases uncertainty about future macroeconomic policy and, therefore, discourages investment. An unsupportable balance of payments position creates instability in the terms of trade which acts to deter investment.

On the fiscal side, large fiscal deficits have an ability to increase uncertainty because government deficits will have to be accounted for in the future either by lowering fiscal spending or raising taxes. This increases the uncertainty about future returns of an investment, which discourages investment. The tax regime also has a critical impact on the investment decision such that a transparent tax system is preferential. Variability in taxation policy whether introducing or removing tax incentives or changing tax rates altogether complicates the investment decision as the option value to undertake investment projects is effected.

There are countless more variables that create instability, and therefore may negatively impact on investment behaviour. Bernake (1983:103) highlights some of these factors that cause economic instability. These include wars and other foreign policy shocks; changes in monetary, fiscal, regulatory or other policy regimes; variations in the conditions of international trade and competition; changes in the level of world supplies of basic industrial commodities; or the advent of a technology with widespread implications, for example, computers. Other factors causing economic instability include the presence of the black market and income inequalities that can increase social tensions.

A matter of debate in the literature is concerned with how government spending on public investment projects affects the level of private investment in a country. The debate is divided between those who suggest public

investment 'crowds out' private investment versus those who favour the 'crowding in' explanation. The crowding out argument suggests that public investment deters private investment by increasing the cost of capital and by lowering the marginal product of the capital stock of the country. On the other hand, the crowding in arguments offers that public investment in infrastructure, education and so on allows private investment to be more productive and, thus, increases the marginal product of capital, which, in turn, promotes further investment spending by the private sector.

Governments typically attempt to create an environment that is hospitable to investors. There are many policy measures that a government can use in order to attain an attractive investment climate. The analysis on the government's influence of macroeconomic variables, detailed above, suggests that the government should pursue policies that reduce instability in these variables. A further condition to the success of government policy has to deal with how credible the potential investor views any policy formation. An investor will proceed with an investment only if they are certain that the government policy is permanent. If, however, the investor perceives there is a possibility that the policy will be reversed then the he or she may defer any potential investment until a later time.

Until investors are convinced that the government policy is permanent, their response in terms of increased investment will not be immediate or dramatic. Investors will defer investment until the economic climate has adjusted to any new policy. This is evidenced by the fact that there is an observed investment pause in the aftermath of adjustment programs in developing countries (Serven, 1996:12). However, if too long a time period passes where there is a poor response to a government policy intended to increase investment levels the result may be delayed growth, increased social hardship and ultimately the reversal of reform, which would confirm investor's initial scepticism. (Serven, 1996:12)

Political factors are becoming increasingly important in the discussion of investment determinants. It is, in part, recognition that the political environment can be a critical influence in promoting and attracting investment in a country. Stability is by far the most cited quality of a political system that is said to impact investment behaviour, which can include a number of different factors. For instance, the democratisation of a political system is believed to have an encouraging impact on investment (see Pastor Jr. & Hilt, 1993). However, the reaction of investors to a political change of this type is typically lagged to ensure the transition is smooth and lasting.

Poirson (1998) provides a list of the political variables that influence the economic environment and indexing the variables to create a proxy intended to quantify their impact. Included are government leadership, external conflict risk, corruption, rule of law, racial and ethnic tensions, political terrorism, civil war threats, quality of bureaucracy (including its degree of independence from political pressure), risk of repudiation of contracts, risk of expropriation by government, political rights and civil liberties. Other political variables not included in this report but which nonetheless influence investment behaviour include the rate of change in governments whereby frequent changes create uncertainty with government policies and the efficiency of the legal system with particular importance on the status of property rights.

***2.3) Does Investment Behaviour Differ Between Foreign and Domestic Investors?***

The aim of this section is not only to focus on the determinants of foreign investment but, more importantly, to assess the extent that foreign investment behaviour differs from domestic investment behaviour.

Foreign investment can take various forms including portfolio investment, debt issues, commercial lending, or foreign direct investment (FDI). Regardless of the form, a foreign investor is as concerned as a domestic investor is about the return and cost of an investment. However, the foreign investor faces additional costs or risks that domestic investors are not subject to which can influence investment behaviour. For example, a foreign investor typically faces larger information asymmetries than their domestic counterparts that can lead to higher information costs to the foreigner. Therefore, it is important to not only determine the variables that affect foreign investment, with a particular interest on the determinants of FDI, but also to distinguish their influence on investment behaviour from the variables highlighted in the previous subsection. FDI is singled out because it is beneficial to developing countries not only because it results in much needed capital inflows but also accrues additional benefits to the host country such as technology transfers and managerial expertise amongst others. Below, the motivations of foreign investment will be examined so that the various factors that influence foreign investment behaviour are better understood.

Generally, an investor looks to undertake an investment project only if it is satisfying the firm's rate of return objectives. The fact that an investment is to take place in a market located in another country may be of some concern to the investor but attractive conditions can provide large enough incentives to undertake such investment. In fact, a theoretical argument in the investment literature suggests that investing in a foreign market, especially a developing one, requires a higher expected profitability than what would normally be accepted in the home market. The reasons for this include larger risks and asymmetric information problems. According to De Mello Jr. (1997:4) 'FDI is an outcome of broad corporate strategies and investment decisions of profit maximising firms facing world wide competition, where significant differences in cost structures, due to factor productivity and remuneration differentials across countries, justify cross border investment and production relocation'.

The traditional determinants of FDI such as market size, GDP per capita, natural resources and an abundance of low-skilled labour have been detailed exhaustively in the literature and will therefore not be repeated at this point. It is worth nothing that the importance of these variables is not to be diminished by their exclusion. However, this section will focus its attention on those variables that differentiate the foreign investor from the domestic investor. In many instances these variables affect both types of investors but the influence of each variable will be distinguished by the particular manner in which it involves the foreign investor.

The importance of access to markets is evident in the patterns of FDI that are directed to large economies such as Brazil or China. In the instance of South Africa, which has a relatively small market, its ability to attract FDI on this basis is limited. Therefore, the instance that a country is part of a regional trade agreement that provides access to regional markets is an important consideration to a foreign investor. Typically, South Africa is

sometimes regarded as an important gateway to Southern Africa. Furthermore, firms that establish production facilities for the purpose of exporting, particularly those taking advantage of export processing zones, will be concerned with the trade regime especially the tariff rates of the host country. Therefore, the openness of the host country is an important determinant of FDI.

The exchange rate is of particular concern to a foreign investor. A convertible currency is required so that profits accruing from operations in the host country can be repatriated in the desired denomination to the home country. In addition, the credibility of the exchange rate is important to a foreign investor such that an over-valuation of the currency is perceived negatively as it threatens the returns of a project and increases uncertainty. A country's balance of payments is an important measure to foreign investors since a large balance of payment deficit can have an impact on the exchange rate, which affects the rate of return. Furthermore, large balance of payments deficits are viewed negatively by foreign investors as this indicates potential problems with capital movements out of the country in the case of profit repatriation and can limit access to foreign exchange.

Firms that undertake FDI are typically large multinational corporations (MNCs) who are able to invest abroad because of oligopolistic advantages. As a result, MNCs will wish to invest in countries where they can take advantage of their firm specific advantages. This is reflected by a foreign investor's concern for strategic considerations, both locally and regionally, determining the market placement of an investment. For example, the degree of competition in the market is important because a lack of competition will allow a firm to capture monopoly rents, which will increase the return of an investment. In addition, a high degree of protection of a market through preventing or limiting entry of competitors, either domestic or foreign, acts as an incentive for FDI by providing large market shares and large returns to a firm. Factors that act as a deterrent to FDI include local content requirements, in terms of inputs to production and management; and strict performance criteria including output restrictions for domestic and export markets and the repatriation of profits to the home country where the parent company is located.

One of the most important influences of a foreign investor is the investment behaviour of domestic firms. The signalling literature examines the relationship between domestic investment levels and foreign investors in more detail (for example, see Johnson, 1997). The argument suggests that because of asymmetric information problems foreign firms rely on domestic investment rates to determine the viability of their own investments. Since foreign investors are not as well informed as domestic firms on the investment climate of the country, foreigners will rely on domestic investment levels as an indicator of market conditions. By using domestic investment rates a foreign firm can determine if an investment project is worth undertaking since high domestic investment rates are considered to be an indication of profitable opportunities.

Government intervention is a central component in influencing FDI flows. Instability within the government puts a damper on investment as the risk of expropriation increases and the possibility that agreements are not followed grows larger. The existence of property rights is critical to the foreign investor as the legal rights of the foreign firm are well established and the threat of expropriation is reduced. In a broader context, the rule of law must be respected to ensure contracts are abided by. In South Africa, the deregulation and privatisation of

the public sector in recent years not only provides many foreign firms with the opportunity to access foreign markets but also indicates a liberal shift towards government interventions in the economy. Likewise, perceptions around political ideology may influence the investment decision as left wing governments are thought to intervene in the economy to a larger degree in comparison to right wing governments by limiting foreign participation or imposing bureaucratic controls and regulations.

There are numerous government policies that are specifically intended to entice foreign firms to invest in that country including incentive schemes and tax holidays, and fiscal and monetary policies. However, the experience is that incentive schemes based on monetary rewards usually have little effect in attracting foreign investors. Investors are more concerned with the general investment climate of the country rather than monetary rewards as such. Indeed, it is argued that countries wishing to attract FDI require a pro-investment regime that will create an attractive investment climate by reducing general uncertainty in the country. For example, poor macroeconomic policy is often seen to be associated with low growth for a given rate of investment and thus potentially a lower rate of investment. Following this line argumentation, if correct, monetary policies should ensure price stability while fiscal policies should aim to improve macroeconomic conditions. Given the irreversibility of investment, firms will typically take time to react positively to policy changes, in terms of increasing investment levels, until they are certain that changes will not be reversed. However, this may be problematic because firms may choose to invest elsewhere rather than wait for conditions to improve in that country.

To summarise, the broad consensus in the literature suggests that in order for investment to occur, an attractive investment climate must be in place. Given that investors base their investment decisions not only on the current economic environment but also their expectations of the future policy makers must reduce uncertainty, ensure stability and thrive for credibility in their actions. Therefore, it is argued that governments should pursue policies that are predictable, sustainable and consistent over time so that forward-looking investors are not deterred to undertake investments but, rather, are confident in the policy framework of the government and general economic conditions of the country. In terms of foreign investors, it is clear that there are numerous variables that differentiate foreign investors from domestic investors. Given that FDI is becoming an increasingly important source of capital to developing countries, along with the positive externalities that accompany it, governments should ensure that policies regard the needs of foreign as well domestic investors.

This section has examined the determinants of investment behaviour from the perspectives of both domestic and foreign investors. The analysis has been based on the relevant literature, which follows theoretical interpretations of investment behaviour. The following sections will outline the theoretical foundations of the firm's investment decision looking at the user cost of capital; adjustment costs, uncertainty and irreversibility; and the costs of financing.

***2.4 User Cost of Capital and Tobin's q***

Two prominent theories in the investment literature are worth starting with. Following the seminal work of Jorgenson (1963) it has been suggested that a firm's capital stock will increase to the level where the marginal product of capital is equal to the user cost of capital. Suppose a firm has an endowment of capital and must decide whether to sell the capital or continue to use the capital in the production process. The cost of continued use, said to be the user cost of capital, includes three implicit costs to the firm. These include the forgone interest of selling the capital and investing the proceeds, the depreciation that results from using the capital, and the changing price of capital. Therefore, the user cost of capital is as follows:

$$r_k(t) = r(t)p_k(t) + \delta p_k(t) - p^{\emptyset}_k(t) \qquad (2.1)$$

where $r_k$ is the user cost of capital, $r$ is the real interest rate, $p_k$ is the real market price of capital, $\delta$ is the depreciation rate, $p^{\emptyset}_k$ is the changing price of capital, and $t$ is the unit of time. The firm will continue to expand its capital stock as long as the marginal product of capital exceeds the real user cost of capital. This formulation leaves, for the moment, aside the tax rate which lowers the rate of return on capital.

The second viewpoint is similar to Jorgenson's, credited to Tobin (1969), which examines investment as the relationship between the market value of capital and the cost of acquiring the capital. The backbone of this theory is Tobin's $q$, which is defined as the ratio of the market value of capital to the replacement cost of capital. The interpretation of $q$ suggests that when $q$ is greater than one a firm will wish to increase it's capital stock, when $q$ is less than one it will decrease it's capital stock and when $q$ is equal to one there is zero investment. Advances in the literature, notably Abel (1983), has shown that marginal $q$, which is defined as the ratio of the market value of a marginal unit of capital to its replacement cost, is a more relevant measure than average $q$ in the investment analysis. Yet, marginal $q$ is considered more difficult to measure than average $q$, which leads to problems in any empirical investigation. Hayashi (1982), however, has shown that there are cases where marginal $q$ and average $q$ are proportional such as when the operating profit function and the augmented adjustment cost function are of the same degree of homogeneity.

While Jorgenson and Tobin have provided useful approaches to examine investment behaviour, the two theories fail in offering a practical explanation of investment. Firstly, numerous assumptions of the models are unrealistic, which results in questionable theoretical outcomes. For instance, if investment is presumed to take place when the marginal cost equals the marginal return of capital, the potential variability of future expectations of returns and costs are being ignored. The models also suggest that changes in the marginal product of capital should result in a change in the capital stock. However, this may be impaired if the firm faces substantial costs of adjusting its capital stock. The real problem with both approaches is that irreversibility adjustment cost are not taken into account.

The recent literature has made dramatic advances in modifying investment models in this regard. Within the past decade or so uncertainty, adjustment costs, and irreversibility have been incorporated into the investment literature. The previous models of Jorgenson and Tobin have not been abandoned entirely -rather they have

been modified to account for these factors, which provides a more realistic picture of the firm's investment decision.

***2.5) Uncertainty, Adjustment Costs and Irreversibility***

The concepts of user cost of capital and Tobin's *q* have been updated with the inclusion of uncertainty, adjustment costs and irreversibility. The models of Jorgenson and Tobin have not been disregarded as irrelevant, rather, the models have been adapted to include these advancements in the investment literature. Although it is apparent that the concepts of uncertainty, adjustment costs, and irreversibility are intertwined it is important to address the impact of uncertainty on investment in it's own right. Therefore, an examination of uncertainty will begin this discussion.

In the broadest sense, uncertainty creates problems by impairing the firm's ability to judge future expectations of the returns and costs of an investment. The entire investment decision is an attempt to predict the profitability of an investment with consideration of the costs of initiating and maintaining it. The best a firm can do is make estimations about the future, using such tools as sensitivity analyses and feasibility studies, to determine the optimal investment project. However, there is never a guarantee that these expectations will actually be realised.

Early work on the link between investment and uncertainty recognised that uncertainty would be of material concern whenever firms make irreversible commitments before the state of the world relevant to the pay off that is to be generated by the commitment is realised. The main finding from this early literature was that under constant returns to scale production technology, and assuming uncertainty to attach to output price, the marginal product of capital is convex in the uncertain output price, such that rising uncertainty raises the marginal valuation of an additional unit of capital and hence *stimulates* investment (see Hartman 1972). While this implication may seem counterintuitive at first sight, it can be readily understood if one considers that the process of investment may itself reveal information about uncertain costs, generating an information value for investment, and increasing its likelihood.

The modern literature has emphasized that such a result need not hold under asymmetric adjustment costs. The discussion tends to be cast in terms of a stochastic dynamic environment. Irreversibility of investment decisions and the possibility of waiting, means that the decision not to invest at the present point in time can be thought of as the purchase of an option. The option has value since waiting to invest in an uncertain environment has information value also, and hence investing now rather than tomorrow has an opportunity cost associated with it. One of the core insights of the modern literature is that uncertainty generates a reward for waiting, and hence that increases in uncertainty will potentially *lower* investment. We will continue by discussing this in more detail.

The importance of uncertainty is apparent when realising that the investment decision is based on firm expectations about the future. Given that deciding to invest is such a tentative choice, even if the decision is supported by the most advanced business tools, there is an obvious need to reduce any uncertainty that may

impact on an investment. A forward-looking investor may regard any measure of uncertainty negatively given that any uncertainty affects expectations of an investment's future profitability. Therefore, uncertainty may result in investment being deferred until a later time when a more positive assessment of the investment environment can be ascertained.

The causes of uncertainty are numerous and have been highlighted in the previous subsection on the determinants of investment. However, it is important to realise the impact of uncertainty on firm investment behaviour can differ across firms. This may not be the case with a macroeconomic shock, such as a war, which will impact all firms in a similar manner. Yet, there are factors that cause uncertainty such as real exchange rate instability, which impact certain firms, say export-oriented firms, more than others. An additional cause of variation of the affect of uncertainty has to do with asymmetric information. Some firms may be better informed than others and, thus, are more affected by events that create uncertainty.

The implications of uncertainty on investment levels are evident in the short-run. An increase in uncertainty will result in investment being delayed, which suggests a lower investment rate in the foreseeable future. However, the long run impact of uncertainty is not as obvious. If uncertainty persists for an extended period of time this results in persistently low investment rates. If the number of firms impacted by this uncertainty is substantial the result will be a low rate of investment in the entire economy, which, in turn, will result in a low rate of economic growth. This can create a viscious cycle whereby a lower growth rate would, in turn, dampen future expectations of profitable investment, which could impair investment even further. Furthermore, the concern of persistent uncertainty would cause firms to fear that their capital stock is too large. This is attributable to uncertainty decreasing the marginal return of current investment and future expectations. Therefore, uncertainty can not only act to discourage investment but also can lead to firm's decreasing their own capital stocks

A problem with the models from the previous subsection relates to the costs of changing one's capital stock. If a firm can instantly and costlessly adjust its capital stock, the investment decision is based on equating the user cost of capital to the marginal product of capital, such that investment occurs when $q$ differs from one. However, if there are factors interfering with an instant and costless adjustment of capital, the investment decision becomes a more complicated matter. Firms will come to consider the magnitude and nature of the adjustment costs in considering the optimal investment path at their disposal. The consequence is that a wedge is driven into the simple expectation that firms will equate the marginal cost and return on capital. Hence, policy makers face more complex demands in any attempt to stimulate investment – since changes in the marginal cost or return on capital due to policy intervention are still subject to the impact of adjustment costs of moving from actual to desired capital stock levels. As a consequence the impact of the policy intervention may be more uncertain.

Adjustment costs, both internal and external, are incurred when a firm decides to change its capital stock. Given the substantial impact on a firm's investment behaviour, adjustment costs have since been incorporated in the $q$ theory of investment. Internal adjustment costs are direct costs a firm incurs when undertaking an investment project. These can include the cost of acquiring and installing new capital, the cost of relocating or discarding

old capital, and training workers to use the capital. External adjustment costs occur when, if capital supplied is perfectly elastic, the price of other goods relative to capital goods adjust so that firms will not invest or disinvest infinitely. When the supply of capital is not perfectly elastic, a change in the capital stock will result in a price change in capital goods that is bid up by the market rather than being a discontinuous change. Therefore, rather than requiring an infinite change in investment as a result of a capital stock change, as noted above in the Jorgenson model, the inclusion of external adjustment costs results in a more realistic explanation of changes in the capital stock.

A recent addition to the literature by Abel & Ederly (1994) is worth noting at this point. The authors incorporate fixed costs in a model that includes adjustment costs. Fixed costs are incurred every time an investment takes place regardless of the level of investment. However, fixed costs of an investment can vary depending on the type of capital flow. Chan-Lau & Clark (1998:5) provide examples of fixed costs, which include transaction costs, market research, feasibility studies and legal analysis. The presence of fixed costs is important because rather than investing where the value of $q$ differs from one, as Tobin's theory suggest, fixed costs create a threshold boundary where investment or disinvestment occurs. In other words, investment or disinvestment will only occur if $q$ is a certain amount above or below one where any value within the boundary, including one itself, will result in zero investment.

A particular controversy in the adjustment cost literature relates to the assumption that suggests that adjustment costs are a convex function of the capital stock. This assumption, which implies that the marginal cost of adjustment is increasing with the size of adjustment, has resulted in criticism in the literature. Consequently, there has been a presentation of different opinions regarding the structure of adjustment costs in the literature. For example, if the assumption of convex adjustment costs is ruled out, investment will occur in episodic bursts rather than as a continuous pattern of investment and disinvestment by the firm.

An important proposition in the adjustment cost literature is the apparent asymmetry with adjustment costs. The argument suggests that it is more costly for firms to reduce their capital stocks than it is to increase them. For example, this can be a result of the fact that capital may be firm specific, which has little use in the general market. What this implies is that investment is irreversible. As a result, a firm has an option value of waiting instead of proceeding with an investment.

The realisation that there is an option value to waiting is an important advancement in the theoretical literature. By patiently assessing market conditions a firm can attempt to determine the optimal timing for an investment. Given the asymmetry of adjustment costs a firm would rather commit itself to a low capital stock with the option of increasing investment in the future, than to build a large capital stock and contend with the difficulty of having to reduce the capital stock, if such a time arises. The firm will delay investment in order to attain more information to base its future expectations on in order to minimise risk and uncertainty. Therefore, a firm will only undertake investment if the marginal value of investing exceeds the marginal value of waiting. In other words, investment occurs when the marginal return of an investment exceeds the marginal cost of an investment by an amount equal to keeping the option value of waiting.

The firm's decision to undertake an investment is not simply a choice weighing the expected returns of one project against the value of waiting but firms must also decide between alternative projects. If a single investment opportunity exists firms measure the option value to wait versus the expected returns of the project. If expectations of future returns are revised downward, uncertainty increases along with the value of waiting, which causes investment to be deferred. However, when there are numerous projects to chose from, the decision process becomes much more complicated whereby the investment decision is determining the path of the total capital stock. If the return of one project changes amongst a group of projects, investment will be delayed even if it the change is positive. This is because a firm will want to wait for more information to determine the ranking of the projects. If the returns of the projects are changing, project rankings may be affected, which results in an increase in uncertainty. This increases the chance that the firm may choose an investment project that is not optimal and, therefore, the firm will defer an investment decision.

A challenge that remains from the literature detailed above is determining how the micro-based theory relates to a macroeconomic context. Aggregate investment typically follows a relatively smooth path over time. This is in contrast to the irreversibility argument in the microeconomic theory, which proposes that firms face a range of zero investments followed by investment occurring in episodic bursts. In order to alleviate this inconsistency between the microeconomic theory and the patterns of aggregate investment one must recognise the heterogeneity of firms. Each firm bases their investment decision on their expectations that an investment project will be profitable, which differs for individual firms across time. While some firms are experiencing their periods of zero investment others are undertaking investment. Therefore, the heterogeneous pattern of firm investment is compatible with the smooth pattern of aggregate investment for the entire economy.

With regards to uncertainty there are shocks that affect specific firms and shocks that affect firms in the aggregate. While an aggregate shock affects all firms, its influence varies across individual firms. Some firms will remain in their boundary of inaction and will not adjust their capital stock while others are pushed beyond their boundary by the shock and will either invest or disinvest depending on the particular direction of the shock. Therefore, the aggregate impact of a shock on investment depends on the number of firms that react to the shock by changing their capital stock. The impact of specific shocks on aggregate investment also depends on the number of firms that are affected. If a large enough number of firms are affected by a specific shock there may be a noticeable impact on aggregate investment. Given that there is a heterogeneous reaction to uncertainty, whether aggregate or specific, the general impact of uncertainty on aggregate investment is not necessarily direct or immediate but rather appears to work itself throughout the economy over time, lending itself to the cyclical swings and smooth aggregate investment exhibits.

It is worth noting that while the micro-level theory is compatible with the aggregate investment patterns it is by now means a complete explanation of aggregate investment. For instance, cyclical swings in investment may be a result of a large gap between aggregate demand and potential output. Investment in the current year can create, at least in dynamic models, an increase in potential output in the following year. If this increase in

potential output is not met by a similar increase in demand in the following year, capacity utilisation may well drop which will result in a decline in investment. This can generate a cyclical movement in investment levels.

While it may appear from the preceding discussion that the impact of irreversibility and uncertainty is at all times to lower investment expenditure, this is not always the case. Remember that we started our discussion with the observation that uncertainty may generate a positive impulse through a rising profitability of investment (since investing may carry information). A further reason for a positive relationship is that while uncertainty increases the threshold level for investment to occur, it also raises the volatility of the threshold so that the latter will be reached more often. This amounts to no more than saying that if the threshold value of investment has risen, this will carry no implications for how often the threshold will be breached under a given level of uncertainty. The net effect of uncertainty on investment is thus ambiguous, and a matter to be empirically determined.

Nevertheless, despite this ambiguity, the implications of the introduction of irreversibility and uncertainty into the investment decision are profound. First, there is the suggestion that the threshold level before which investment occurs is higher than the basic model would suggest. Second, it implies the relative decrease in importance of other determinants of investment expenditure such as the real interest rate and the tax treatment of capital stock, and a greater significance for volatility and uncertainty in the economic environment. But perhaps most important is the shift in perspective that the alternative theory of investment offers. Both irreversibility and uncertainty introduce an opportunity cost to investing now rather than in the future, since failing to wait foregoes additional information on the investment project, and hence raises the threshold before which investment does not take place.

***2.6) Costs of Financing***

The previous analysis concerned itself with the timing of the firm's investment and their motivations for doing so. This section attempts to examine the means by which firms invest, specifically looking at the cost of financing to the firm. The importance of this section is in part to determine if South Africa has a savings constraint. The financial development of the country and the availability of credit to the firm will be examined for this purpose.

The theoretical models examined above focussed on the firm's decision to invest as a choice of the marginal value of an investment and the marginal cost of an investment, in its most basic terms, with further consideration of the value of waiting. While Jorgenson's user cost of capital, for instance, considered the cost of capital as an important factor influencing the investment decision none of the models were explicitly concerned with the financing structure of the firm. For example, the user cost of capital is based on the assumption that firms would face a cost of capital set in centralised markets without regard for individual firm characteristics and their financial structure. Such investment models are based on theoretical assumptions of capital markets developed by Modigliani and Miller where financial factors have no impact on the investment decision. However, given the capital markets imperfections that exist, this interpretation necessitates the call for a new

model based on more realistic assumptions. This section will proceed by determining how financing costs influence the investment behaviour of the firm.

An important aspect of the financing cost literature deals with the difference between internal financing and external financing. The firm itself sources internal financing with either retained earnings or already existing owner's equity. External financing is funded through either debt finance or issuing shares, which is attained in the open market. Each type of financing has characteristics that influence the firm's investment decision. For example, internal finance tends to avoid moral hazard problems; debt finance increases the debt-equity ratio, which may be perceived negatively by investors and lenders; and issuing shares dilutes the ownership structure and may harm the current share value. However, by far the most important characteristic that a firm is concerned with is the cost associated with a particular form of financing.

Extensive analysis in the literature, particularly from the pecking order or financing hierarchy theories, suggest that there is a cost advantage of internal finance compared to external finance, which makes internal finance preferable to external finance. Numerous factors play a part in creating this gap including tax advantages, transaction costs, asymmetric information and capital market imperfections. Asymmetric information is a result of lenders not having full information regarding borrowers. Lenders cannot determine the true value of a firm and the expected returns of an investment project as this information is privy to the firm's managers. Since the lenders cannot distinguish between those firms that are high quality and those that are low quality a lender will demand a 'lemons premium'. This is charged above the normal market-clearing borrowing rate as a means to offset the losses incurred from funding bad projects.

This adverse selection problem results in lenders incurring monitoring costs to reduce the asymmetric information uncertainty. However, the result is higher costs to the lender who, in turn, passes these costs onto the borrower in the form of higher financing costs. Asymmetric information also causes moral hazard problems with the firm's managers. Given that there is limited liability with debt contracts managers may, in some instances, act in their own self-interest by diverting funds. Managers may also unnecessarily undertake risky projects instead of ones that are low risk, which results in suboptimal investment projects being pursued instead of the most efficient projects (Fazzari, Hubbard & Peterson, 1988a:151). In an attempt to curb this behaviour by managers, lenders can incorporate certain criteria in their contracts such as targeted debt-equity ratios that would limit manager discretion.

Financial market imperfections such as asymmetric information result in agency costs that act to disrupt the flows of funds from lenders to borrowers. Agency costs are assumed to decrease with the expected payoff of the project and the amount of self-financing the firm contributes and increase with the degree of asymmetric information and the amount that is borrowed. Capital imperfections also cause variables to have a more pronounced effect on investment behaviour than they would if perfect capital markets existed. For example, average tax rates affect the return of an investment but in the presence of capital market imperfections they also reduce the firm's cash flows. This decreases funds available for internal financing, which can impede investment spending. Changes in interest rates will alter the cost of an investment, however, in an imperfect

capital market these changes give rise to uncertainty that increase agency costs. The result is that external finance will be more expensive, which deters capital spending.

Given the cost advantage of internal finance, firms may wish to finance investment with their available cash flows. Those that exhaust all of their internal finance are faced with the problem of acquiring external finance in the capital market. However, since external finance is more expensive, firms will only invest if the marginal product of an investment is greater than the marginal cost of externally financed capital. Some firms may, in fact, have no inexpensive source of external funds, which will prevent any further investment. Substantial spreads between the cost of internal and external finance can be attributed to such characteristics as the firm's size, it's age, it's relationship to industrial and financial groups, the presence of bond rating or commercial paper programme, or the firm's dividend policy (Hubbard, 1998: 201). For example, young firms are more dependent on external finance than older, more established firms yet may have no inexpensive source of external funds because of larger information asymmetries.

What the above suggests is that the financial system plays an important role influencing investment behaviour. The literature argues (see Levine & Zervos, 1998) that financial deepening plays a positive role on the level and rate of growth in an economy and is a good predictor of future growth potential. Given that the financial sector allocates capital in a market, the argument suggests that a better-developed financial market can better allocate capital to its most efficient use. This is a direct result of a more developed financial market being better skilled at reducing problems such as moral hazard and adverse selection, which causes a reduction in the cost of external financing.

Rajan and Zingales (1998) argue that financial development should be measured not only by the ease that borrowers and lenders are brought together but also the confidence they have in another. The authors suggest that 'the development of the financial system is related to the variety of intermediaries and markets available, the efficiency with which they perform the evaluation, monitoring, certification, communication and distribution functions, and the legal and regulatory framework assuring performance' (p.569). Therefore, a well-developed financial market should be better equipped to ensure credit availability and, thus, reducing the problems of credit constraints. Their findings indicate that the development of the financial system has an important impact on investment and, in turn, economic growth by reducing the cost of external finance to credit constrained firms.

### *2.7) Investment Demand Models*

One of the challenges in the investment literature is incorporating theoretical advancements into an empirical investment model. It is apparent from an examination of the empirical literature that the theoretical analysis of the previous sections has developed much faster than the literature that attempts to estimate investment models. The greatest problem is the complexity of including theoretical concepts into an empirical estimation. For example, there is an apparent difficulty with measuring uncertainty and instability, or there are problems with incorporating non-linear investment rules. However, there have been recent attempts to include such concepts in an empirical investment model by way of proxies, or reduced form estimations. This section will begin by presenting various baseline models of investment, particularly neo-classical models that use the cost of capital

and incorporate the *q* theory of investment, and then proceed by adapting these models for factors such as uncertainty, instability and financial factors.

The neo-classical model of investment, as proposed by Jorgenson, is a model where the demand for capital is determined by the user cost of capital, most notably, and other relative prices of inputs and outputs. The production process takes the form of a Cobb-Douglas production function where labour and capital are the only two inputs to production, indicated by:

$$q_t = f(\iota_t, \kappa_t) \tag{2.2}$$

where $q$ is output, $\iota$ is labour and $\kappa$ is capital stock. The firm's optimal level of capital is a dynamic demand problem that is determined over a specified time horizon (in discrete or continuous time as may be the case), where investment is determined by depreciation of the existing capital stock and the change in the demand for capital. This is indicated by:

$$I_t = \delta\kappa_t + \Delta\kappa_{t+1} \tag{2.3}$$

where $I$ is gross investment and $\delta$ is depreciation.

An important corollary of this model is the assumption that the objective of the firm is to maximise its present value, measured primarily by its profits. According to Romer (1996:349) if adjustment costs are ignored, profits are proportional to a firm's capital stock, $\kappa_t$, and decreasing in the industry-wide capital stock $K_t$, which can be denoted as $\pi(K_t)\kappa_t$. This is based on the assumptions that the production function has constant returns to scale, output markets are competitive, the supply of all factors other than capital are perfectly elastic and the demand curve of the industry's product is downward sloping[3]. To incorporate adjustment costs, the primary assumption is that they are a convex function of the firm's capital stock. This suggests that the cost to adjust one's capital stock is increasing with the size of adjustment. Noting that the change in capital stock is equal to net investment (gross investment minus depreciation), adjustment costs can be denoted $C(I_t)$. Therefore, the firm maximises its present value over an infinite time horizon according to:

$$J = \Sigma\ [1/(1+r)^t][\pi(K_t)\ \kappa_t - I_t - C(I_t)] \tag{2.4}$$

subject to the constraints presented in equations (2.2) and (2.3). Fielding (1997:350) suggests that since the firm's output is dependent on capital stock and labour, and assuming that goods and factor markets are competitive, the firm's planned capital stock ($\kappa_{t+1}$) can be determined as follows:

$$\kappa_{t+1} = g(E[(r_k)_{t+1}], E[w_{t+1}], \kappa_t) \tag{2.5}$$

[3] As soon as adjustment costs are introduced, one has moved away from the baseline Jorgenson model, to something like an Eisner-Strotz (1963) model.

where $w$ is the real wage, $r_k$ is the user cost of capital [defined in equation (2.1)], $E[]$ is the expectations operator and $\delta_t$ reflects the existence of adjustment costs. Therefore, gross investment is given by the following equation:

$$I_t = \delta k_t + \Delta k_{t+1} = f(r_k, E[(r_k)_{t+1}], w_t, E[w_{t+1}], k_t) \tag{2.6}$$

Depending on a number of assumptions, an investment model can be designed from the above equation. Firstly, the user cost of capital as defined in equation (2.1) may be too complex for empirical estimation, particularly the changing price in capital parameter. To simplify, the user cost of capital can be set equal to:

$$(r_k)_t = r_t(p_k)_t + \delta(p_k)_t \tag{2.7}$$

Furthermore, assume that the expected values of $w$, $p_k$, $r_t$, depend on past and present values and the capital stock can be expressed as a function of past investment levels with weights depending on the rate of depreciation. Currently only relative costs of capital have been considered as the factors that affect the demand for capital. For completion, the neo-classical model must include factor prices in the model. Therefore, the level of output or sales in the model, which capture the impact of factor prices on investment demand, must be included in the model. In this instance the model will include firm sales, denoted $s$. Therefore, the general investment model can be written as follows:

$$I_t = f[(p_k)_{t,\ldots t-n}, r_{t,\ldots t-n}, w_{t,\ldots t-n}, I_{t-1,\ldots t-n}, s_{t,\ldots t-n}] \tag{2.8}$$

Such a model can be extended or modified in a number of ways. For instance, Fielding (1997) includes public investment given its impact on aggregate output and also differentiates between traded and non-traded capital goods. Fielding suggests that disaggregating investment into traded and non-traded capital goods is necessary because consumption and production patterns in developing countries depend not just on the relative price of non-traded goods, as is proposed in the Dutch Disease literature, but also on the relative prices of the different kinds of capital (p.351).

Since equation (2.8) is a general baseline model, other variables can be included to modify the model in light of theoretical advancements. Macroeconomic variables that affect investment, as detailed in the above sections, can just as easily be included in the investment model. For example, theory suggests that GDP, in terms of both past and current output, can act an indicator of future output growth and, thus, influence current investment levels. Therefore, GDP may be incorporated in the model to be estimated empirically.

Another consideration is to incorporate theoretical concepts such as uncertainty, instability and financial factors. Serven (1996) presents a general overview of the empirical work that has attempted to include uncertainty and instability into an investment demand model. Many of the papers highlighted incorporate uncertainty in the investment model via the volatility of macroeconomic variables. Some measures include the volatility of variables such as real GDP, real exchange rates, terms of trade and inflation. Other measures of uncertainty

include the variability in the marginal profitability of capital on the investment threshold and the probability of public policy reform reversal, which highlights the impact of credibility on investment.

The impact of political instability on investment has also been incorporated into some investment models. Factors that contribute to political instability include rapid government turnover, conflict or violence, income inequalities, property rights and the level of democracy. However, the biggest problem with including political instability variables is the difficulty in measuring these variables. Empirical studies have used dummies, created indexes and used proxies in order to include various political factors in an investment model. Financial factors can also be easily incorporated into the investment model. A common means to determine if firms are credit constrained is to include the firm's cash flow in the regression. Cash flows are a good indicator of the level of internal finance available to the firm. Therefore, if a cash flow variable is found to be positive and statistically significant the results indicate that the firm is credit constrained.

Another type of investment modelling is based upon the *q* theory of investment demand. Such models emphasise market valuations of the firm's assets as the determinant of investment. A general reduced form (as used by Fazzari Hubbard & Peterson, 1988a) is as follows:

$$(I/K)_t = f[(X/K)_t, (CF/K)_t] \tag{2.9}$$

where $I$ is investment in plant and equipment; $K$ is the beginning-of period capital stock; $X$ represents a vector of variables, possibly including lagged values, that have been emphasised as determinants of investment from a variety of perspectives; and $CF$ is the firm's internal cash flows, which indicate the firm's financing capabilities.

Following theory outlined above in the previous sections a firm will invest as long as the marginal product of capital exceeds the marginal cost of capital. Using the *q* theory of investment an investment model can be identified as:

$$(I/K)_t = f[(Q)_t, (CF/K)_t] \tag{2.10}$$

where $Q$ is the sum of the value of equity and debt less the value of inventories, divided by the replacement cost of the capital stock adjusted for corporate and personal income taxes. Fazzari *et al* (1988a:169) suggest that there are potentially two problems with measuring $Q$ in this regard that may bias the estimation. First, to the extent the stock market is excessively volatile, $Q$ may not reflect market fundamentals. Second, the replacement capital stock in $Q$ may be measured erroneously. To deal with this problem the authors suggest the inclusion of lagged $Q$ to be used as an instrumental variable or include first and second differences to address measurement error problems.

Another popular model is based upon the sales accelerator theory where the firm's investment decision is determined primarily by changes in sales or output. Cash flows are normally incorporated into the model to

determine the firm's ability to raise finance internally and, thus, determine if the firm is credit constrained. The model is identified as follows:

$$(I/K)_t = f[(S/K)_t, (CF/K)_t] \tag{2.11}$$

where $(S/K)$ is the ratio of sales to the beginning-of-period capital stock. The model can be modified so that $Q$; lagged sales variables; or the level of debt, which captures financing constraints of the firm are included in the model. While this model has performed well in empirical estimation, a failing of the model is that it does not incorporate the relative price of capital or capital services.

Other models of investment do exist in the empirical literature. However, many deal with the relationships between investment and other variables such as economic growth or savings, rather than investment demand on its own. For example, Poirson (1998) models investment in relation to it's impact on growth estimating a two equation model with private investment and growth as endogenous variables and including variables that capture political and uncertainty factors. The model is based on the theory that private investment levels influence output per worker, which in turn, impact on the aggregate growth rate. The model is as follows:

$$PIY_t = f[YGPC_{t-1}, SEC_t, CV_t, ESV_t] \tag{2.12.1}$$

$$YGPC_t = f[YLPC_{t-1}, POPG_t, SEC_t, PIY_t, CV_t, ESV_{it}] \tag{2.12.2}$$

where *PIY* is the rate of private investment, *YGPC* is the growth rate of per capita *GDP*, *SEC* is the enrolment ratio in secondary school, *CV* is set of policy reforms and other factors influencing private investment outcomes, *ESV* is the set of economic security variables. *YLPC* is the level of real GDP per capita and *POPG* is the population growth.

Odedokun (1992) presents a model of reduced form equations that recognises the joint determination and accounting identity linking the trio of investment, domestic saving and foreign saving. The mutual causation between these three variables indicates that one variable should not be made an independent variable in the equation for the other irrespective of whether or not a simultaneous equation method of estimation is utilised. Rather, the author suggests that the following model be used:

$$I_t = f[\Delta Y_t, RINT_t, CREDIT_t, FORESV_t, REX_t, GYW_t] \tag{2.13.1}$$

$$S_t = f[\Delta Y_t, RINT_t, CREDIT_t, FORESV_t, REX_t, GYW_t] \tag{2.13.2}$$

$$F_t = f[\Delta Y_t, RINT_t, CREDIT_t, FORESV_t, REX_t, GYW_t] \tag{2.13.3}$$

where *I* is per capita real capital formation; *S* is per capita real domestic savings; *F* per capita real foreign saving; $\Delta Y$ is the per capita change in real GDP; *RINT* is the real interest rate; *CREDIT* is the per capita domestic real credit flow; *FORESV* the per capita stock of real foreign reserves; *REX* the real exchange rate (real domestic currency per SDR); and *GYW* is the world economic growth rate. An estimation using these three equations constitutes a model of the flow of funds for the whole economy, as opposed to selected sectors.

***2.8) South African Investment Literature***

As was illustrated in the previous sections the fundamental determinants of investment, either domestic or foreign, include the cost of capital, macroeconomic variables, political considerations, uncertainty and stability measures and so on. The goal of this section is to examine the current literature that attempts to explain investment behaviour in South Africa basing the analysis on how the variables discussed above are incorporated or neglected. By using the findings of the previous sections the current gaps in the South African literature can be identified as areas for further research. The review below is by no means comprehensive. It merely attempts to highlight some of the important work done on the country.

*User Cost of Capital*

Work from the South African Reserve Bank by Pretorius (1997) examines the macroeconomic determinants of gross fixed investment, with a particular focus on the cost of capital. The paper examines a range of factors that influence private fixed investment. Variables with inverse relationships with fixed investment include the user cost of capital, following Jorgenson's definition, and the corporate tax rate; and a lagged inverse relationship with the long term interest rate, as measured by the yield on long term government bonds. The assumed desired capital stock and the capacity utilisation rate are both found to have a positive relationship with fixed investment in the private sector. The major conclusion of the report indicates that there is an inverse relationship between real sector private fixed investment and the real user cost of capital. The report concludes that the cost of capital in South Africa drives investment and that high user costs of capital induces lower investment rates.

*Uncertainty*

More recent work (Fielding, 1997) has looked at aggregate investment in South Africa incorporating economic uncertainty and political instability. The study estimates investment functions for two separate capital goods, traded and non-traded capital goods, where political and economic uncertainty are included in the models along with relative output prices and the costs of the factors of production. There are two uncertainty variables included; one measured as a linear combination of variability of returns, costs of capital and indices of industrial unrest, while the second is measured by the number of strikes per year. The estimated model uses annualised aggregate data for the period 1946-92 in South Africa.

Fielding's findings suggest that there are asymmetries in the behaviour of the two types of capital. Traded capital investment is more sensitive to public investment and the terms of trade and less sensitive to capital goods prices and measures of uncertainty. In the aggregate traded goods and non-traded goods are found to be substitutes. The results also indicate that changes in the prices of goods and factors rather than aggregate demand have a greater impact on investment levels. Given the greater impact of these factors this implies that cost factors of an investment have an important influence on investment behaviour. Increases in market interest rates reduce investment demand so there appears to be no financial repression at the aggregate level. Furthermore, in the aggregate, firms do not appear to face quantity rationing in goods or credit markets. These results are evidenced by an insignificant credit availability variable, which measures the degree to which firms are credit constrained. Therefore, it is suggested that policies designed to improve long run investment

performance should focus on instruments that affect relative prices given the importance of cost factors of an investment. Examples of instruments that affect relative prices include direct taxes which affect the real price of capital and tariffs which affect the internal terms of trade.

*Foreign Direct Investment*

More prevalent is research that looks at a broad checklist of what are good and bad indicators for investment potential. There is a wide range of research papers that reflect investor's perceptions of what the major factors are in attracting investment. For example, Van der Walt & de Wet (1995) examine the determinants of foreign investment in South Africa. The authors argue that the current literature is inundated with research providing checklists of FDI determinants, which fails to provide a general framework that explains FDI. Therefore, while numerous variables effect the investment decision, expected profit is the key variable in the decision to invest according to the authors. Some factors influencing expected profit in South Africa include exchange rate controls, political stability, fiscal discipline and the economic role of government, labour stability, size of public debt, inflation and protectionism.

An examination of these variables is used to evaluate how South Africa compares with other countries. The results suggest that South Africa fares poorly on virtually every conceivable determinant of prospective profit with the exception of monetary policy. Given the investment needs of the country to increase economic growth and reduce unemployment, estimated at a net inflow of at least R3 billion to R5 billion per year, a dramatic turn around is required in FDI flows. With South Africa's poor rating on the variables that influence expected profit the task ahead is all the more difficult.

Mbekeani (1997) broadly examines FDI to developing countries presenting trends and the determinants of FDI, and the relationship between FDI and economic growth. In terms of determinants, the author finds numerous variables have an impact on the decision of a firm to undertake FDI. These include market size, changes in the level of GDP, manufacturing profitability, relative production costs, availability of skilled labour, United States interest rates and large external debts.

In the author's examination of FDI and economic growth it is suggested that the relationship between FDI and economic growth have been taken for granted such that the emphasis has been on policy measures used to attract FDI flows rather than the mechanisms through which FDI promotes growth. Since FDI's contribution to growth and employment is at best small, policy makers may want to emphasise promoting domestic investment with FDI used as a supplement for supporting domestic investment accumulation. Measures to promote investment include increasing educational enrolments; lowering current account deficits without altering government investment levels; improving infrastructure; blending trade and investment policies; targeting sectoral investment, particularly in sectors with comparative advantages, positive externalities and export orientation; moderate investment incentives; and government interventions to solve market failures.

*Financial Sector Factors*

Edwards (1998) examines the South African financial sector to determine its capability in promoting saving and investment as a means to pursue the economic goals of the country. The author takes a critical stance on the current neo-liberal policies adopted by the government, namely high interest rates and free market forces. It is argued that high real interest rates do not act to encourage savings or investment as evidenced by the trends in East Asia and South Africa. Therefore, it is proposed that South Africa take a more interventionist approach in order to bring about an increase investment, which will foster higher income, savings and economic growth.

An interventionist approach suggested by Edwards would result in the government discarding its current regime of high real interest rates in favour of lower but positive real interest rates. In doing so private sector investment would not necessarily increase, but the debt burden of the government would decrease. This would allow public sector investment to increase. In light of this, the government can shape the composition of investment in South Africa, for instance, directing investment to the undeveloped rural market or approved industrial developments. In addition, the state can also take the initiative to not only increase the quantity of savings but also improve the quality of savings. The principal suggestion of the paper is that reform of the South African financial system is necessary in order to finance an increase in government expenditure at the lowest possible cost and to subordinate financial policy to the rapid growth of the real economy spearheaded by an integrated industrial policy.

Bell *et al* (1999) examined the impact of the availability of credit on the sectoral investment in South Africa using a sample of manufacturing firms. A sales accelerator investment model was used, which included cash flows and debt to capture the financing constraints of the firm. The specification tested (Harris *et al*, 1994:38) was as follows:

$$I_{i,t} / K_{i,t-1} = \beta + \beta_2(\Delta S_{i,t} / K_{i,t-1}) + \beta_3(CFi,t / Ki,t\text{-}1) + \beta_4(D_{i,t} / K_{i,t-1}) + \beta_{i,t} \qquad (2.14)$$

where $I$ is investment, $K$ is capital stock, $S$ is sales, $CF$ is cash flow, $D$ is debt, $\beta$ is the error term, $i$ is the firm subscript and $t$ is the time subscript. The coefficient $\beta_2$ is expected to be positive. The coefficient $\beta_3$ captures the firm's ability to raise finance internally and, if significant and positive, indicates that the firm is credit constrained. The $\beta_4$ coefficient reflects the premium above the safe rate that must be paid as the debt-to-capital ratio increases and is expected to differ across firms and between periods.

Using panel data estimations numerous regressions were run to incorporate the trade performance variables, employing both full sample regressions and divided sample regressions based upon firm classifications. The separate results, in a sense, enforced the findings of one another, however, with some surprising results. In regards to credit constrained firms, both export-oriented and those with a high change in their contribution to trade balance were found to be less credit constrained than their counterparts, in accordance with expectations. However, high export growth firms were found to be more credit constrained than low export growth firms, contrary to expectations. This causes any general conclusions on the relationship between trade performance and capital market imperfections to be limited.

*Summary*

Table 2.1 provides a summary of some earlier studies' findings in South Africa as well as elsewhere.

Table 2.1: Summary of some recent empirical findings of investment expenditure functions

| Study | Year | Application | Main finding |
|---|---|---|---|
| Bean | 1981 | UK Manufacturing | Investment is found to be dependent on the real cost of capital, and nominal interest rate. |
| Driver & Moreton | 1991 | UK Manufacturing | Uncertainty carries a negative impact on investment. Growth uncertainty carries a long term effect. Inflation uncertainty carries a short term effect. |
| Ferderer | 1993 | US Manufacturing | Uncertainty has a negative and significant impact on investment. Uncertainty carries a bigger impact than the cost of capital or $q$. |
| Fielding | 1997 | SA Aggregate | Investment dependent on relative output prices, costs of factors of production and indices of political and economic uncertainty. |
| Gilchrist et al | 1998 | US Manufacturing | Investment depends on both fundamentals and financial variables. |
| Hassett et al | 1998 | Sample of countries | Investment is sensitive to real user cost of capital. Tax incentives are important and their effect is on capital stock rather than capital prices. |
| Alesina et al | 1999 | OECD | Find negative impact of fiscal policy and particularly the public wage bill on investment; taxes also carry a negative impact. |
| Bloom et al | 1999 | | Analysis is based on irreversibility approach and finds uncertainty to be important in augmenting the Euler & $q$ theories |
| Cabbalero et al | 1999 | US Manufacturing | |
| Darby et al | 1999 | France, Germany, Italy, and US | Germany & Italy confirm $q$-theory. In France the cost of capital is of importance (Jorgenson). For the US neither $q$- nor Jorgenson model appear to be relevant. All countries show negative impact of uncertainty on investment |
| Fielding | 1999 | SA Manufacturing | User cost of capital, as well as aggregate demand variables are important; Both macro- and micro- indicators of risk are important |
| Guiso et al | 1999 | Italy | Uncertainty has negative impact on investment. Irreversibility enhances the negative uncertainty impact. |
| Mairesse et al | 1999 | US, France | Declining importance of credit rationing. |
| Price | 1995 | UK Manufacturing | Uncertainty has negative impact. Adjustment to equilibrium is nonlinear and the adjustment slows in presence of uncertainty. |

*Source: Fedderke (2000).*

Discussions of empirical work on investment functions in LDC's can be found in Rama (1993) and Serven & Solimano (1993). From this and the above it is clear that ample work needs to be done in examining investment in South Africa so that investment behaviour in the country is better understood. Of primary importance is that empirically based research should attempt to examine the variables that influence investment spending. Economic theory identifies these variables but empirical research can be used to determine the extent to which microeconomic and macroeconomic variables affect investment behaviour. In addition, variables overlooked in past studies in the South African literature such as uncertainty and instability should be included in any empirical research. This is particularly important given the current evidence that indicates these variables have a considerable influence on investment in the developing world, including South Africa. Furthermore, studies should examine the influence of the financial sector variables on investment behaviour with a particular interest on determining if South African firms are financially constrained. Once the variables that impact investment behaviour are determined one can attempt to ascertain how the government can best influence these variables, if at all. Given that government policy can positively influence variables an attractive investment climate can be pursued more effectively. By undertaking such research public policy intended to encourage or attract investment in South Africa can be better designed and implemented. After this theoretical exposition and review of research on the determinants of investment in South Africa and elsewhere we will turn in the next section to the data sources used for the empirical work presented in sections 4 and 5.

# Section 3. Data Sources

### *3.1) Introduction*

The descriptive analysis (see section 4 below) and the econometric analysis (see section 5 below) are based on long term trends for a range of sectors and a number of economic variables. This section will describe in broad terms the relevant data sources underlying these time series.

Long term economic trends for a number of economic variables are available for a limited number of production activities in the South African economy, at the 1 digit SIC level, from Stats SA and the SARB Quarterly Bulletin. On the other hand, at a lower level of sectoral detail, time series are only available for limited periods of time. There is, however, a great need for a consistent set of time series at a more detailed sectoral level for a long period and a wide range of economic variables both in the public and private sector. The report makes use of a set of sectoral data compiled by WEFA for 38 sectors of the South African economy. The sectors are listed in the following table.

Table 3.1: Sectoral disaggregation

| | SIC code (5th ed) | Sector description | | SIC code (5th ed) | Sector description |
|---|---|---|---|---|---|
| 1. | 11-13 | Agriculture, forestry & fishing | 20. | 341 | Glass & glass products |
| 2. | 21 | Coal mining | 21. | 342 | Non-metallic minerals |
| 3. | 23 | Gold & uranium ore mining | 22. | 351 | Basic iron & steel |
| 4. | 22, 24, 25, 29 | Other mining | 23. | 352 | Basic non-ferrous metals |
| 5. | 301-304 | Food | 24. | 353-355 | Metal products excluding machinery |
| 6. | 305 | Beverages | 25. | 356-359 | Machinery & equipment |
| 7. | 306 | *Tobacco* | 26. | 361-366 | Electrical machinery |
| 8. | 311-312 | Textiles | 27. | 371-373 | Television, radio & communication |
| 9. | 313-315 | Wearing apparel | 28. | 374-376 | Professional & scientific equipment |
| 10. | 316 | Leather & leather products | 29. | 381-383 | Motor vehicles, parts & accessories |
| 11. | 317 | Footwear | 30. | 384-387 | Other transport equipment |
| 12. | 321-322 | Wood & wood products | 31. | 391 | Furniture |
| 13. | 323 | Paper & paper products | 32. | 392 | Other industries |
| 14. | 324-326 | Printing, publishing & recorded media | 33. | 41-42 | Electricity, gas & steam |
| 15. | 331-333 | Coke & refined petroleum products | 34. | 51-53 | Building construction |
| 16. | 334 | Basic chemicals | 35. | 61-63 | Wholesale & retail trade |
| 17. | 335-336 | Other chemicals & man-made fibres | 36. | 71-72 | Transport & storage |
| 18. | 337 | Rubber products | 37. | 81-83 | Finance & insurance |
| 19. | 338 | Plastic products | 38. | 93-99 | Community services |

The following variables are currently fully or partly covered:

Table 3.2: Economic variables covered in the sectoral time series data base

| | | | |
|---|---|---|---|
| 1. | Gross value of output (sales, current pr) | 8 | Gross domestic fixed investment by type of asset (constant |
| 2. | Value added (GDP, current pr) | 9 | Capital stock by type of asset (constant 1990 pr) |
| 3. | Gross value of output (sales, constant 1990 pr) | 10 | Employment by skill level |
| 4. | GDP deflators | 11 | Capacity utilisation |
| 5. | Labour remuneration (current pr) | 12 | Exports (current pr) |
| 6. | Gross operating surplus (current pr) | 13 | Imports (of final goods, current pr) |
| 7. | Depreciation by type of asset (constant 1990 pr) | | |

It is the purpose of this section to provide a broad overview of the sources that have been employed in compiling the data series. The description will be kept at a broad level because of the many detailed complications involved in trying to generate a set of consistent times series from disparate data sources. We will start with variables related to sectoral production which include: gross value of production, value added, GDP, wages and salaries and gross and net operating surplus and capacity utilisation. We, then, turn our attention to

employment and subsequently to capital stock, depreciation and gross and net domestic investment. We continue with a brief discussion of the data sources on international trade at the sectoral level. Finally, it was argued in the previous section that variables overlooked in past studies in the South African literature such as uncertainty and instability should be included in any empirical research. This is particularly important given the current evidence that indicates these variables have a considerable influence on investment in the developing world, including South Africa.

***3.2) Production***

In this section we review the data sources used for variables such as gross value of production, value added, GDP, wages and salaries and gross and net operating surplus and capacity utilisation.

*Value added*

Gross domestic product (GDP) or value added is according to Moh *et al* (1995) the total value of all final goods and services produced within the economy in a given period. No provision has been made for depreciation and contrary to gross value of production (or sales or turnover see elsewhere) the concept avoids double counting.

GDP or value added is estimated quarterly by Stats SA for the production side of 9 main sectors (1 digit SIC, P0441), while the SARB estimates total GDP from the expenditure side and adds a residual term to ensure consistency between the two estimates. The production method estimates of GDP sums the contribution of each industry to GDP. Contributions are measured in terms of value added which is equal to a firm's total output less intermediate inputs (locally produced or imported). Value added is also equal to what is available for distribution to the factors of production in the form of wages and salaries (production factor labour) and profits, rent, depreciation, interest and dividends (production factor capital).

At the disaggregated sectoral level a range of data sources are employed to fit value added over the period 1970-1998. Prior to 1994, unpublished Stats SA data are the main source for value added at the subsectoral level. Recently, the GDP estimates by Stats SA were expanded to include a number of subsectors (P0441) for about 10 manufacturing sectors, 4 mining sectors and a number of services sectors that is backdated to the year 1993. Moreover, at a lower level of detail, the various sectoral censuses (see Annexure 3.A) are employed together with input-output tables for selected years (see Annexure 3.B) and long term data series on sales or gross value of production (such as P2041 for mining and P3041 for manufacturing). Some smoothing has been undertaken in order to joint the various data sources into a coherent set of series that are consistent with the national accounts.

*Wages and salaries*

Of the components of value added (at factor costs), wages & salaries and allowance for depreciation (see elsewhere) are estimated from source, while net operating surplus (profit, rent, interest and dividend), is considered to be the residual. Wages & salaries, or labour remuneration is the total amount paid to employees in money or in kind and includes salaries and wages, bonuses and employers' contributions to pension and provident funds. According to Mohr *et al* (1995), total wages and salaries paid out by each sector and subsector during the relevant periods have traditionally been available along with the employment data for the non-agricultural sectors (see employment description elsewhere). More recently Stats SA published employment, wages & salaries, average wages & salaries per worker both in nominal and real prices as part of the South African Labour Statistics. Stats SA deflates current-price series to obtain constant-price series (i.e., series of real salaries and wages) by means of the CPI. Unlike the series on employment, currently, no data sources are available to generate a consistent time series for wages and salaries by skill level.

*Gross and net operating surplus*

Gross operating surplus at the sectoral level is estimated as the difference between value added at factor costs (see above) and wages and salaries as described in the previous section. Net operating surplus is derived by subtracting allowance for depreciation (see below) from gross operating surplus.

*GDP Deflators*

GDP deflators at the sectoral level are based on a range of sources. As a basis WEFA uses value added for the 9 main sectors at the 1 digit SIC level available from Stats SA and published in SARB Quarterly Bulletin. Stats SA used to publish sectoral value added at current as well as constant prices but this effort was abandoned . Recently, Stats SA started publishing value added for a limited number of sectors (P0441) both in constant and current prices. This series is back dated to 1993 and is tied in with the earlier unpublished sector data from Stats SA. Limited use is made of Stats SA's PPI series (P01421) to integrate the various data sources. Stats SA's PPI series (P01421) is also used to convert gross value of production from current to constant prices.

*Capacity utilisation*

Capacity utilisation is defined as the ratio of potential and actual output (gross value of production) and is available from Stats SA (P3043). The underlying data is based on surveys and Stats SA and is also able to provide information on the reason for underutilisation (shortage of raw materials, skilled or unskilled labour and demand and other reasons), however, the series do not go back further than 1986. Unpublished data from Stats SA offers a longer term perspective at the detailed manufacturing level although this is not broken down by type of reason. Capacity utilisation data is only available for manufacturing sectors.

***3.3) Employment***

According to Mohr *et al* (1995) labour statistics are fraught with conceptual and measurement problems. In South Africa official labour statistics have traditionally been regarded as unreliable. The definitions and sources of some of the most important official data on employment and unemployment are given in this section. In

addition we discuss sources of total employment, followed by an overview of the data sources used to break total employment down by skill classes.

*Total employment by sector*

At the aggregate skill and occupation groups level, official labour statistics have been published annually since 1993, measured in the middle of the year, by Stats SA in South African Labour Statistics (Mohr *et al*, 1995). Some of these statistics are released regularly in the P series of Statistical News Releases and published in the Bulletin of Statistics such as P02421 for manufacturing and mining, P0244 for services, P0262 for financial institutions and P7142 for transport services. Employment figures indicate the number of paid employees and include casual and seasonal workers. In most cases annual data are shown as at 30 June of the relevant year. Other private sector data are based on monthly or quarterly sample surveys. Separate estimates of employment in agriculture are also published.

*Employment by skill level and sector*

Employment by skill level is measured for 42 economic sectors in the Manpower Survey in odd years from 1969 to 1987 and for each year thereafter to 1994. For the even years employment by skill is estimated between 1969 and 1987 through linear interpolation. The skill composition of employment for each of these sectors is estimated to the most current year (1997) by projecting historical trends in the composition of employment to 1997. Some smoothing is done to the data in the instances where extreme fluctuations occur in certain years. The final skill composition for each sector is applied to total employment estimates for that sector discussed above. The following sectors are identified.

Table 3.3: Sectoral disaggregation for employment by skill

| | |
|---|---|
| 1. Coal mining | 21. Basic non-ferrous metals |
| 2. Gold mining | 22. Fabricated metals |
| 3. Other mining | 23. Machinery |
| 4. Food | 24. Electrical machinery |
| 5. Beverage | 25. Professional & scientific equipment |
| 6. Textiles | 26. Motor vehicles and parts |
| 7. Clothing | 27. Other manufacturing |
| 8. Leather | 28. Electricity |
| 9. Footwear | 29. Building |
| 10. Wood | 30. Civil engineering |
| 11. Furniture | 31. Wholesale/retail |
| 12. Paper and paper products | 32. Accommodation |
| 13. Printing | 33. Transport |
| 14. Coal and petroleum products | 34. Communication |
| 15. Other chemicals | 35. Finance and insurance |
| 16. Basic chemicals | 36. Business services |
| 17. Rubber and plastic products | 37. Community services |
| 18. Glass | 38. Recreational services |
| 19. Non-metallic minerals | 39. Other services |
| 20. Basic Iron and Steel | |

This sectoral disaggregation of Table 3.3 does not quite coincide with that of Table 3.1. A reconciliation of the employment by skill available for the sectors shown in Table 3.3, and the total employment for the sectors shown in Table 3.1 was undertaken by means of proportional scaling. The reconciliation process can be separated in to two distinct parts. In the first place, where sectors in Tables 3.1 and 3.3 coincide, possible differences in total employment are eliminated by adopting the total employment estimates for the sectors shown in Table 3.1 as the benchmark. Employment by skill are derived by means of proportional adjustment based on the distributions for the relevant sectors in skill level data base. In the second phase, special attention is

paid to a number of sectors shown in Table 3.1 that are not shown in Table 3.3. We will deal with them in turn detail below.

*Agriculture*
We use the 1991 population census as our guideline and apply the fixed distribution of employment by skill for this sector across the whole period 1970-1991. It appears that highly skilled personnel (professionals, other professionals, technical managerial occupation groups) account for less than 1% of persons employed in agriculture, skilled personnel (clerical, sales, transport, service personnel and artisans) for just over 2% and the rest is semi-and unskilled labour. We assume that this distribution is more or less constant over the period of review.

*Tobacco*
No data was available on employment by skill. We use the skill distribution of beverages as our guideline.

*Furniture*
It would appear that the furniture sector as indicated in row 11 of Table 3.3 refers to wooden furniture only. In the 5$^{th}$ edition of the SIC, a new sector (31) is introduced which covers wooden furniture as well as metal furniture. The latter was in the 4$^{th}$ edition covered by the Fabricated metal sector (sector 22 of Table 3.3). We accommodate this by applying the weighted average of the skill distribution of Table 3.3 for the Furniture and Fabricated metals sector.

*TV and radio products*
The TV, radio and communication equipment producers (sector 27 of Table 3.1) decomposition of employment by skill is derived using the Electrical machinery producers distribution of skill (sector 24 of Table 3.3).

*Community services and other producers*
Employment series of Table 3.3 identify Community services (sct 37, Table 3.3), Recreational services (sct 38, Table 3.3) and Other services (sct 39, Table 3.3), while the total employment series identifies Community services (sct 38, Table 3.1). The weighted average skill composition of Community services (sct 37, Table 3.3), Recreational services (sct 38, Table 3.3) and Other services (sct 39, Table 3.3) is used to derive the skill composition of Community services (sct 38, Table 3.1).

### *3.4) Investment, Depreciation and Capital Stock*

The description here is mainly taken from Mohr *et al* (1995). Capital as a factor of production represents produced goods which are used as factor inputs for further production. Examples of reproducible capital goods include: plant, machinery, buildings, roads and bridges. Reproducible capital can therefore be distinguished from land and labour which are not produced inputs. Capital goods can also be distinguished from consumer goods. Consumer goods are used to satisfy current needs whereas capital goods are used over a period of time as factors of production in the production process.

The fixed capital stock is the aggregate or sum of capital goods in an economy or sector at a given point in time and is therefore a *stock* concept. The measurement of the stock of capital by a single number requires the

somewhat bold assumption that the diverse components of the capital stock (e.g. machinery, plant, roads, buildings) can be expressed in a common unit (money) and summed to obtain a measure of the physical stock of capital in the economy.

Investment (or capital formation) is the flow of expenditure on new capital goods. It can also be defined as the flow of expenditure on new goods that are not intended for immediate consumption. Investment can take the form of physical capital (or fixed investment) as well as inventory investment. Gross domestic fixed investment is the addition to the country's fixed capital stock during a specific period, before provision for depreciation. Gross domestic investment consists of both fixed and inventory investment before provision for depreciation. Net domestic investment equals gross domestic investment after provision for depreciation. Finally, Gross domestic fixed investment (GDFI) is equal to gross domestic investment excluding inventory investment. Net domestic fixed investment is GDFI after provision for depreciation.

The fixed capital stock can therefore be defined as the accumulation of net domestic fixed investment (i.e. GDFI after provision for depreciation) over time. The fixed capital stock at constant prices represents the physical volume of capital assets in the economy and can as such be used as an indicator of production capacity.

Depreciation is the reduction in the value of the fixed capital stock as a result of wear and tear as well as redundancy (technologically or otherwise) over a period of time and is therefore a *flow*. Depreciation or the consumption of fixed capital is recognised as a cost of production. The decline in the value of a capital good is calculated over the projected economic life of the good, which varies according to the type of asset (e.g. machinery, plant and buildings). In South Africa annual provisions for depreciation are conventionally calculated by means of the straight line method. The cost of the asset is divided by the number of years of its expected life to yield annual depreciation figures. However, during inflationary periods replacement costs exceed historical costs and provisions for depreciation based on historical cost are therefore inadequate. This problem is dealt with by periodically revalueing assets with a price index of capital costs and adjusting the depreciation allowance accordingly (replacement cost depreciation).

The major source of data on investment, depreciation and the capital stock is the *SARB Quarterly Bulletin*. This publication contains quarterly and annual data on the various investment concepts (including depreciation). Data on the fixed capital stock at constant prices are also published on an annual basis. The following is a summary of the categories of data published.

- Annual data on the fixed capital stock are published, for the economy as a whole as well as for the nine major sectors (i.e. by kind of economic activity) and the three types of organisation (public authorities, public corporations and private business enterprises). These data are published at constant prices. The capital stock for a given year is estimated at 31 December of that year.
- The methodology employed by the SARB was first developed for South Africa by Kok (1981) and is based on the *perpetual inventory method*. Given a starting year for which capital stocks are available at the desired level of disaggregation, the method involves the accrual of real net fixed investment for those years for

which no capital stock data is available. The advantage of the method is that it is relatively easy on basic data requirements for those years for which no census material is available. The method is also consistent with national accounting principals.

- GDFI is published for the nine sectors and the three types of economic organisation at both current and constant prices. GDFI for the three types of economic organisation is further disaggregated to show the investment in three broad types of capital assets, i.e.,
  - residential buildings, non-residential buildings, construction works
  - transport equipment
  - machinery and other equipment
- Real net domestic fixed investment is not published but can be calculated from the published fixed capital stock figures (at constant prices) for the major sectors. The current year's net domestic fixed investment at constant prices is merely the difference between the current and previous year's capital stock at constant prices.
- Annual depreciation is only published at replacement value for the total economy. It can, however, be estimated for each of the major sectors of the economy as follows: calculate real net domestic fixed investment as mentioned above; then subtract the result from real GDFI; this yields depreciation of the fixed capital stock at constant prices which can then be transformed into the depreciation figure at replacement cost. This is done by multiplying it by an appropriate investment deflator. Investment deflators for the different sectors can be calculated by dividing GDFI at current prices by GDFI at constant prices.
- The relationship between capital stock, gross domestic investment and depreciation can be described by the following relationship

$$K_t = K_{t-1} + I_t - \delta \qquad (3.1)$$

in which $K_t$ is the capital stock at the end of period $t$, $I_t$ gross domestic fixed investment undertaken and $\delta$ depreciation during period $t$. Net domestic fixed investment is equal to the term $I_t - \delta$.

- Further disaggregation of the data described above by economic activity is undertaken by WEFA based on published ((P3042.3) and unpublished capital expenditure data from Stats SA. Gross and net fixed investment and depreciation are derived in the same way as described above and consistency with the SARB published data is ensured. Further disaggregation is not available for non-mining, non-manufacturing sectors. The latest year for which data is available is 1997, which is still in 1990 constant prices.

***3.5) International Trade***

Stats SA publishes imports and exports for the broad commodity groups of the 22 chapters of Customs and Excise. These data cannot easily be reconciled with the 38 sectors of Table 3.1 and also the series do not go back further than 1988. Prior to 1988, Customs and Excise made available import and exports for detailed Standard International Trade Classification (SITC) which was converted to the Harmonised Code (HS) system in 1988. Both series have been now been merged by WEFA into a consistent series for 38 sectors (at this stage only at current prices). The allocation of HS groups to the 38 sectors of Table 3.1 is undertaken at the 8 digit

level. There are almost 10 000 codes at this level and it is beyond the scope of this document to report on the bridge.

***3.6) Uncertainty and political instability***

Finally, it was argued in the previous section that variables overlooked in past studies in the South African literature such as uncertainty and instability should be included in empirical research on investment behaviour. This is particularly important given the current evidence that indicates these variables have a considerable influence on investment in the developing world, including South Africa.

The ERSA political instability index is constructed on the basis of official and unofficial sources, which were placed in a weighted composite index of instability in accordance with alternative weightings[4]. The series contains the following components

- The number of prosecutions under the Defence Acts, and Emergency regulations.
- The number of prosecutions for "faction fighting".
- The number of people proscribed and/or banned under the Suppression of Communism Act 1951.
- The number of people placed in detention.
- The number of political fatalities.
- The number of organisations officially banned.
- The number of actions against "riots".
- Declarations of official states of emergency.
- The number of publications subjected to censorship.

Given the uncertainty surrounding the appropriate weighting of the components of the repression series, a number of alternative weightings were presented to a panel of South African experts drawn from a range of disciplines[5]. The favoured index was constructed on the basis of the advice and suggestions received from this panel. For more detail see the discussion in Fedderke, De Kadt & Luiz (2000).

This concludes the discussion of the data sources. The next section focuses on a descriptive analysis of the sectoral time series, notable those for GDFI and capital stock.

[4] For a full discussion see Fedderke, De Kadt & Luiz (1999a).
[5] Leading authorities in political science, sociology, law, economic history, and history.

***Annexure 3A: Statistics SA Sectoral Censuses***

Table 3A.1: Stats SA Sectoral Census and Input-Output Data Sources Utilised

| Description | Report No. |
|---|---|
| Census of Agriculture, 1993 | |
| - Western Cape | 11-02-02(1993) |
| - Eastern Cape | 11-02-03(1993) |
| - Northern Cape | 11-02-04(1993) |
| - Free State | 11-02-05(1993) |
| - Kwazulu-Natal | 11-02-06(1993) |
| - North West | 11-02-07(1993) |
| - Gauteng | 11-02-08(1993) |
| - Mpumalanga | 11-02-09(1993) |
| - Northern Province | 11-02-10(1993) |
| Census of mining, 1993 | 20-01-01 (1993) |
| Census of manufacturing, 1993 & 1996 | 30-01-01 (1993) |
| Census of construction, 1994 | 50-01-01 (1994) |
| Census of wholesale trade, commercial agents and allied services, 1993 | 61-01-01 (1993) |
| Census of retail trade, 1993 | 62-01-01 (1993) |
| Census of the motor trade and repair services, 1993 | 63-11-01 (1993) |
| Census of catering and accommodation services, 1993 | 64-01-01 (1993) |
| Census of transport and allied services, 1993 | 71-01-01 (1993) |
| Census of letting of own fixed property, 1993 | 83-02-01 (1993) |
| Census of renting and leasing of machinery and equipment, 1977 | 04-09-01 (1977) |
| Census of Professional and Business Services, 1993 | |
| - Data Processing | 86-01-01(1993) |
| - Legal Services | 88-01-01(1993) |
| - Accounting, Auditing and Bookkeeping Services | 88-02-01(1993) |
| - Consulting Engineering Services | 88-03-01(1993) |
| - Architectural and Quantity Surveying Services | 88-05-01(1993) |
| - Advertising Practitioners and Allied Services | 88-06-01(1993) |
| - Employment Placement Agencies, Recruiting Organisations and Labour Broker's Services | 88-07-01(1993) |
| - Security Services | 88-08-01(1993) |
| - Cleaning Services | 88-09-01(1993) |
| - Hairdressing and Beauty Services | 95-01-01(1988) |
| Census of Medical, Dental and other Health Services, 1994 | |
| - Doctors | 93-02-01(1994) |
| - Chiropractors, Homeopaths, Naturopaths, | 93-03-01(1994) |
| - Herbalists | 93-06-01(1994) |
| Census of Veterinary Services, Animal Hospitals and Care Centres | 93-04-01(1994) |

***Annexure 3B: Input-Output Tables***

Table 3B.1: Input-Output Tables

- Report No. 09-16-02 Input-output tables, 1971.
- Report No. 09-16-04 Input-output tables, 1975.
- Report No. 09-16-05 Input-output tables, 1978.
- Report No. 09-16-05 Input-output tables, 1981.
- Report No. 09-16-05 Input-output tables, 1981 (Imports separately).
- Report No. 04-02-01 (1984) Input-output tables, 1984.
- Report No. 04-02-02 (1984) Input-output tables, 1984 (Imports separately).
- Report No. 04-02-01 (1988) Input-output tables, 1988.
- Report No. 04-02-02 (1988) Input-output tables, 1988 (Imports separately).
- Report No. 04-02-01 (1989) Input-output tables, 1989.
- Report No. 04-02-02 (1989) Input-output tables, 1989 (Imports separately).

# Section 4: Descriptive Analysis

### *4.1) Introduction*

The main aim of this section of the report is to present a preliminary analysis of the sectoral data[6]. Given the data problems frequently encountered on South African data, such a review has the advantage of not only identifying potential obstacles to more sophisticated analysis, but also to assess the plausibility of some alternative explanations of investment in South Africa on the basis of a relatively simple exploratory data analysis.

Initial evidence point to two distinct forms of structural change in the South African capital market.

- Firstly, relative capital usage by economic sector has been subject to distinct long-run changes over 1970 to 1997.
- Secondly, the 1990s represent a critical period in South Africa investment history with the emergence of a series of manufacturing sectors that maintained the highest investment rates on average.This marks the first time point in the 1970-97 time frame in which manufacturing sectors constituted such an unambiguous leadership position amongst South African economic sectors

One possible reason for the restructuring of the South African capital markets may be a declining degrees of capital market distortions in the economy. What is noticeable about 1970's and 1980's investment rates, is that there is a strong presence of sectors with heavy state-led investment activity amongst sectors maintaining sustained high levels of investment expenditure. Such heavy state-led demand for investment goods could have had distortionary impacts on the cost of capital. Those sectors with heavy reliance on state intervention show strong declines in their investment activity during the course of the 1990's, to be replaced by sectors with less government intervention which may well have been crowded out by state activity in earlier decades. Although the techniques employed in the next section will be more appropriate, this assertion already raises the question whether increased reliance on market forces in the policy environment of the 1990's has stimulated a restructuring of the South African economy and capital market and whether this may have had the result of improving the efficiency of production in South Africa.

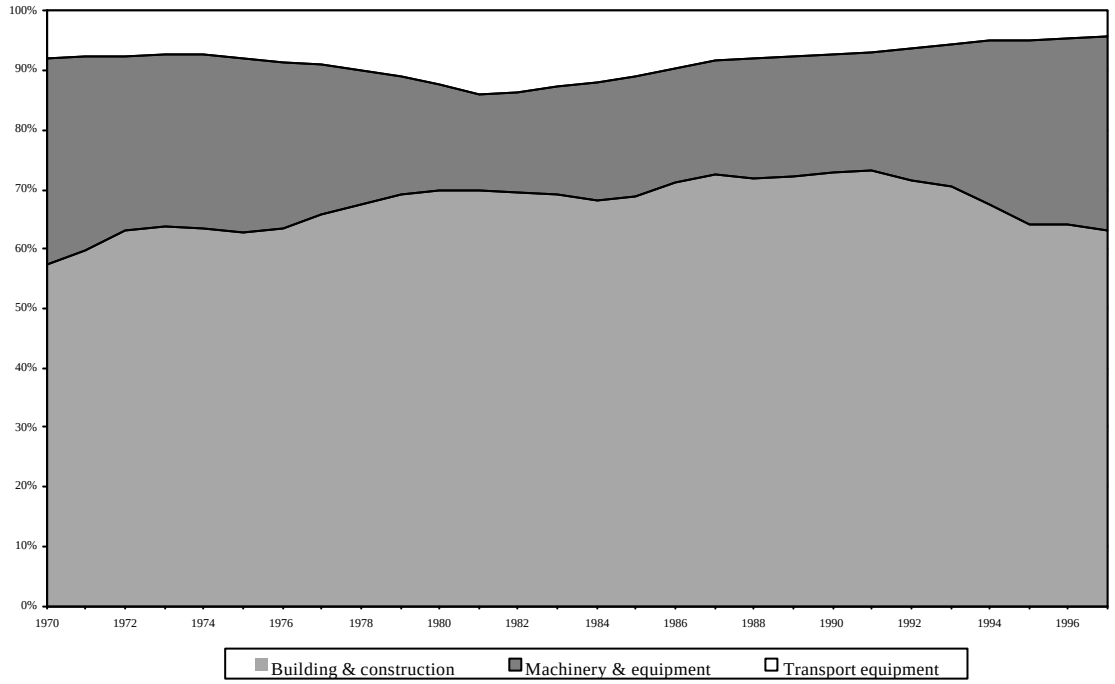
### *4.2) Overview of capital stock by asset type*

Our data base list three classes of capital stock on a sectoral basis:

- Buildings (residential & non-residential) & Construction
- Transport Equipment.
- Machinery & Equipment

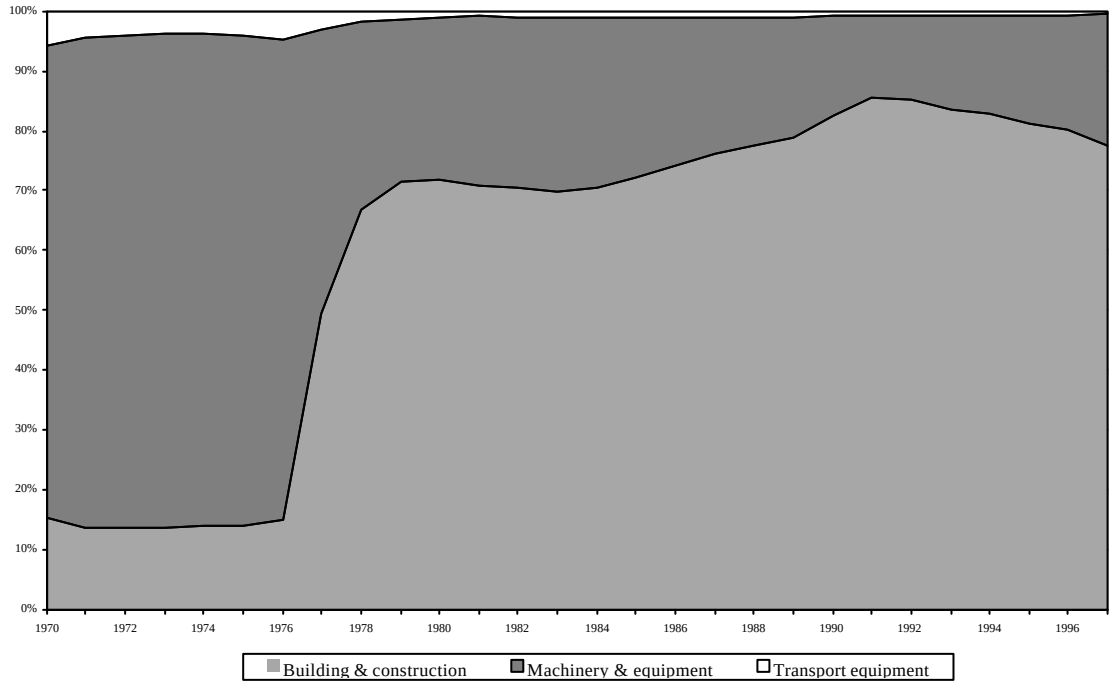
In the rest of the report, the use of Machinery & Equipment is considered the more appropriate measure of capital stock. Nevertheless we start with a brief overview of the proportion of total capital stock contributed by Buildings & Constructions, Machinery & Equipment, and Transport Equipment by economic sector. Figures 4.1 and 4.2 provide an illustration for two arbitrarily chosen sectors, in this case Food and Petroleum Refining.

Figure 4.1: The distribution of the food processing capital stock across asset types




*Source: own calculations*

Figure 4.2: The distribution of the petroleum refinery sector capital stock across asset types




*Source: own calculations*

It can be seen that although the composition of capital stock in the food processing sector is relatively stable, in the petroleum refinery sector the composition changed dramatically in the late 1970s with the expansion of

[6] The discussion of the present section draws on the material presented in Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b).

SASOL, which is reflected in a much higher share of capital stock allocated to building (especially non-residential) and construction. This is one indication of the extent of state involvement in capital stock creation in the South African economy.

In Table 4.1 it can be seen that on average for selected subperiods, Buildings & Construction constitutes the largest proportion of the total capital stock (greater than 50%) for the majority of sectors. The only exceptions to this over the full sample period are Plastics, Radio, TV and Communications Equipment, and Construction, for which Machinery & Equipment was the single most important source of capital. However, for a few of the sectors machinery & equipment became a more important component of capital stock during the course of the 1970-97 sample period.[7]

Table 4.1: The distribution of capital stock across asset types for selected periods (%)

| 1. | | | Buildin | Buildin | Buildin | Mach | Mach | Mach | Trnsp | Trnsp | Trnsp |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2. | | | 1970s | 1980s | 1990s | 1970s | 1980s | 1990s | 1970s | 1980s | 1990s |
| 3. | 11-13 | Agriculture, forestry & fishing | 74.6 | 74.2 | 83.3 | 19.9 | 22.2 | 13.9 | 5.5 | 3.6 | 2.8 |
| 4. | 21 | Coal mining | 66.7 | 64.7 | 75.7 | 31.1 | 34.0 | 23.2 | 2.1 | 1.4 | 1.0 |
| 5. | 23 | Gold & uranium ore mining | 77.3 | 68.0 | 74.8 | 21.2 | 31.0 | 24.5 | 1.5 | 1.0 | 0.6 |
| 6. | 22, 24, 25, | Other mining | 53.3 | 54.9 | 41.7 | 41.5 | 42.5 | 55.5 | 5.3 | 2.6 | 2.9 |
| 7. | 301-304 | Food | 63.6 | 70.3 | 68.4 | 28.0 | 18.8 | 26.0 | 8.4 | 10.9 | 5.6 |
| 8. | 305 | Beverages | 63.3 | 75.3 | 71.2 | 27.9 | 18.2 | 24.9 | 8.9 | 6.5 | 3.8 |
| 9. | 306 | Tobacco | 61.3 | 69.6 | 60.6 | 30.5 | 24.6 | 34.7 | 8.3 | 5.8 | 4.8 |
| 10. | 311-312 | Textiles | 50.6 | 55.4 | 57.5 | 46.1 | 39.4 | 39.2 | 3.2 | 5.2 | 3.4 |
| 11. | 313-315 | Wearing apparel | 54.9 | 50.1 | 49.2 | 37.3 | 39.2 | 42.9 | 7.8 | 10.7 | 7.9 |
| 12. | 316 | Leather & leather products | 65.0 | 61.2 | 55.9 | 27.0 | 29.9 | 38.7 | 7.9 | 8.9 | 5.4 |
| 13. | 317 | Footwear | 61.8 | 64.8 | 62.2 | 33.9 | 28.1 | 33.9 | 4.3 | 7.1 | 4.0 |
| 14. | 321-322 | Wood & wood products | 62.4 | 68.0 | 69.4 | 27.7 | 18.8 | 23.7 | 9.9 | 13.2 | 6.9 |
| 15. | 323 | Paper & paper products | 60.8 | 52.1 | 46.9 | 36.1 | 45.1 | 50.4 | 3.1 | 2.7 | 2.7 |
| 16. | 324-326 | Printing, publishing & recorded media | 57.0 | 59.2 | 50.1 | 37.2 | 32.9 | 44.1 | 5.8 | 7.9 | 5.8 |
| 17. | 331-333 | Coke & refined petroleum products | 28.7 | 73.2 | 82.3 | 67.6 | 25.7 | 17.0 | 3.7 | 1.1 | 0.7 |
| 18. | 334 | Basic chemicals | 46.4 | 67.6 | 80.7 | 49.6 | 28.4 | 17.4 | 4.0 | 4.0 | 2.0 |
| 19. | 335-336 | Other chemicals & man-made fibres | 49.0 | 49.4 | 63.5 | 47.8 | 48.4 | 34.1 | 3.2 | 2.2 | 2.4 |
| 20. | 337 | Rubber products | 53.1 | 66.0 | 57.4 | 42.9 | 28.4 | 38.0 | 4.0 | 5.6 | 4.6 |
| 21. | 338 | Plastic products | 24.6 | 36.3 | 30.2 | 69.8 | 55.1 | 65.9 | 5.6 | 8.5 | 3.9 |
| 22. | 341 | Glass & glass products | 73.2 | 71.1 | 63.7 | 23.9 | 23.8 | 31.7 | 2.9 | 5.2 | 4.6 |
| 23. | 342 | Non-metallic minerals | 57.1 | 71.5 | 77.2 | 36.5 | 22.5 | 20.7 | 6.4 | 6.0 | 2.1 |
| 24. | 351 | Basic iron & steel | 48.7 | 63.0 | 59.3 | 49.8 | 35.1 | 39.8 | 1.6 | 1.9 | 0.8 |
| 25. | 352 | Basic non-ferrous metals | 50.6 | 63.0 | 62.0 | 47.5 | 33.0 | 36.5 | 1.9 | 4.0 | 1.5 |
| 26. | 353-355 | Metal products excluding machinery | 45.5 | 53.0 | 56.4 | 44.9 | 35.4 | 36.1 | 9.6 | 11.6 | 7.6 |
| 27. | 356-359 | Machinery & equipment | 50.3 | 55.1 | 68.3 | 39.8 | 33.5 | 25.6 | 9.9 | 11.5 | 6.1 |
| 28. | 361-366 | Electrical machinery | 46.3 | 52.2 | 70.7 | 46.2 | 36.8 | 25.1 | 7.5 | 11.0 | 4.2 |
| 29. | 371-373 | Television, radio & communication | 33.4 | 42.0 | 48.7 | 57.1 | 47.0 | 45.4 | 9.5 | 11.0 | 5.9 |
| 30. | 374-376 | Professional & scientific equipment | 48.0 | 51.5 | 67.2 | 41.9 | 31.5 | 23.8 | 10.1 | 17.0 | 9.1 |
| 31. | 381-383 | Motor vehicles, parts & accessories | 53.2 | 61.7 | 55.7 | 40.0 | 30.6 | 35.0 | 6.8 | 7.7 | 9.3 |
| 32. | 384-387 | Other transport equipment | 77.1 | 86.4 | 82.8 | 20.3 | 9.7 | 15.4 | 2.7 | 3.8 | 1.8 |
| 33. | 391 | Furniture | 55.7 | 45.2 | 50.0 | 28.2 | 33.8 | 34.6 | 16.1 | 21.0 | 15.4 |
| 34. | 392 | Other industries | 66.6 | 60.6 | 83.7 | 27.2 | 28.3 | 13.8 | 6.2 | 11.1 | 2.5 |
| 35. | 41-42 | Electricity, gas & steam | 63.9 | 47.4 | 52.2 | 35.6 | 52.1 | 47.2 | 0.5 | 0.5 | 0.6 |
| 36. | 51-53 | Building construction | 21.1 | 24.6 | 33.4 | 52.7 | 56.0 | 54.0 | 26.2 | 19.4 | 12.6 |
| 37. | 61-63 | Wholesale & retail trade | 72.6 | 74.5 | 74.2 | 17.6 | 17.7 | 17.6 | 9.8 | 7.8 | 8.2 |
| 38. | 71-72 | Transport & storage | 58.9 | 60.0 | 61.5 | 7.3 | 9.0 | 9.8 | 33.8 | 31.0 | 28.7 |
| 39. | 81-83 | Finance & insurance | 74.4 | 71.6 | 70.0 | 4.3 | 4.5 | 5.9 | 4.3 | 8.1 | 6.8 |
| 40. | 93-99 | Community services (incl general govt) | 99.5 | 99.6 | 99.3 | 0.4 | 0.3 | 0.6 | 0.1 | 0.0 | 0.0 |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: 1990s is the period 1990-1997*

Perhaps more interesting are changes in the proportion of total capital stock contributed by the various sources of capital equipment. Table 4.2 below briefly reports which part of each sector's capital stock has constituted a rising proportion of total capital stock over the sample period.

[7] Viz.: Diamond & Other Mining, Clothing, Leather, Paper, Publishing & Printing, Glass & Glass Products, Furniture and Transport & communication.

Table 4.2: The changing composition of capital stock

| Increasing Buildings & Construction | Increasing Machinery & Equipment | No Change in Proportions |
|---|---|---|
| 1. Agriculture, Forestry & Fishing | 1. Gold & Uranium Mining | 1. Food |
| 2. Coal Mining | 2. Diamond & Other Mining | 2. Footwear |
| 3. Beverages | 3. Wearing Apparel | 3. Tobacco |
| 4. Textiles | 4. Leather & Leather Products | 4. Wholesale & Retail Trade |
| 5. Wood | 5. Paper | 5. Community Services |
| 6. Petroleum Refining | 6. Publishing & Printing | 6. Transport, Storage & |
| 7. Basic Chemicals | 7. Plastics | 7. Finance, Insurance & Real Estate |
| 8. Other Chemicals | 8. Glass & Glass Products | |
| 9. Other N-Met Minerals | 9. Basic Iron & Steel | |
| 10. Bas N-Ferrous Metals | 10. Radio, TV & Comms Equip | |
| 11. Fabricated Metals | 11. Motor Vehicles | |
| 12. Machinery & Apparatus | 12. Furniture | |
| 13. Electrical Machinery | | |
| 14. Instruments | | |
| 15. Transport Equipment | | |
| 16. Other Manufacturing | | |
| 17. Construction | | |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b)*

We briefly report developments in the level of capital stock in each of the available dimensions, before moving on to a more detailed analysis of the role of Machinery & Equipment on a sectoral basis. Evidence highlights a potential difficulty when considering total capital stock in South Africa. A narrow focus on total capital stock is potentially misleading, since on occasion strong changes in one of Building & Construction (see for instance Petroleum refining)[8] or Transport Equipment may distort one's understanding of the investment performance of sectors in the South African economy.

*Rank of Sectors: Building and Construction*

Table 4.3 reports the rank of sectors in terms of their stock of Building & Construction (in Rand values). Little change occurs in terms of the relative size of the Building & Construction stock of the industries. In terms of the rank of the sectors, Petroleum refining (+20), Other manufacturing (+5), Plastics (+5) are the only ones that increase their stock of Buildings & Construction significantly. Given the inclusion of the SASOL projects under Petroleum refining, the strong change in plant in this sector is hardly surprising. Sectors with declining relative importance of Buildings & Construction are Textiles (-13), Fabricated metals (-9), Wearing apparel (-8), Non-metallic minerals (-6) and Agriculture, Forestry & Fishing (-5), though only one sector, Wearing apparel, had negative average annual growth rates in Buildings & Construction).

While the average annual growth rate in Buildings and Construction of Petroleum refining (+32%) dominates that of all other sectors, a number of other sectors nevertheless reported average annual growth rate above 5%. Thus, if only total capital stock per sector is considered as a basis for the computation of net investment, the dimension of Buildings & Construction could potentially provide distorted implied investment rates, if the focus of the investment rate analysis is on fixed capital stock of sectors. . Other manufacturing (+9.79%), Coal mining (+9.61%), Basic non-ferrous metals (+8.47%), Basic chemicals (+7.82%), Beverages (+7.53%), Plastics (+6.63%), and Motor vehicles & accessories (+5.07%) all showed strong increases in their Building & Construction stocks over the 1970-97 period, and might thus be prone to such distorted net investment rates if total capital stock is considered.

[8] Though we are not confident that the distinction between Machinery & Equipment and Building & Construction is always consistently applied across sectors. Particularly for mining, for instance, what may be classified as Building & Construction (such as a mineshaft), may be more appropriately viewed as capital stock in the standard sense.

Table 4.3: Sectoral capital stock: Building and Construction

| | 1970 rank | 1980 rank | 1990 rank | 1997 rank | change in rank 1970-97 | unweight average annual growth 1970-97 | rank unweight average annual growth 1970-97 | st dev unweight average annual growth 1970-97 | rank st dev unweight average annual growth 1970-97 |
|---|---|---|---|---|---|---|---|---|---|
| Professional & scientific equipment | 1 | 1 | 2 | 3 | 2 | 4.53% | 27 | 0.0917 | 31 |
| Leather & leather products | 2 | 2 | 1 | 1 | -1 | 1.23% | 5 | 0.0560 | 18 |
| Plastic products | 3 | 8 | 8 | 8 | 5 | 6.63% | 32 | 0.0827 | 28 |
| Footwear | 4 | 4 | 3 | 4 | 0 | 1.71% | 8 | 0.0472 | 12 |
| Tobacco | 5 | 6 | 4 | 2 | -3 | 0.88% | 4 | 0.0983 | 33 |
| Television, radio & communication equipment | 6 | 5 | 6 | 5 | -1 | 2.25% | 9 | 0.0586 | 19 |
| Other industries | 7 | 7 | 9 | 12 | 5 | 9.79% | 37 | 0.4031 | 37 |
| Furniture | 8 | 3 | 5 | 7 | -1 | 2.77% | 13 | 0.0855 | 29 |
| Glass & glass products | 9 | 10 | 11 | 9 | 0 | 4.44% | 26 | 0.0923 | 32 |
| Rubber products | 10 | 11 | 10 | 10 | 0 | 3.19% | 17 | 0.0665 | 25 |
| Coke & refined petroleum products | 11 | 31 | 31 | 31 | 20 | 32.16% | 38 | 1.0516 | 38 |
| Wood & wood products | 12 | 14 | 13 | 13 | 1 | 3.21% | 18 | 0.0553 | 16 |
| Other transport equipment | 13 | 19 | 14 | 15 | 2 | 4.14% | 25 | 0.1021 | 34 |
| Wearing apparel | 14 | 9 | 7 | 6 | -8 | -1.76% | 1 | 0.0263 | 5 |
| Printing, publishing & recorded media | 15 | 13 | 12 | 11 | -4 | 1.58% | 6 | 0.0509 | 14 |
| Building construction | 16 | 18 | 18 | 18 | 2 | 4.00% | 24 | 0.0349 | 8 |
| Electrical machinery | 17 | 12 | 16 | 16 | -1 | 3.36% | 19 | 0.0628 | 22 |
| Basic non-ferrous metals | 18 | 16 | 17 | 23 | 5 | 8.47% | 35 | 0.1256 | 35 |
| Machinery & equipment | 19 | 17 | 20 | 19 | 0 | 2.94% | 15 | 0.0557 | 17 |
| Motor vehicles, parts & accessories | 20 | 21 | 22 | 21 | 1 | 5.07% | 30 | 0.0550 | 15 |
| Beverages | 21 | 24 | 25 | 25 | 4 | 7.53% | 33 | 0.0802 | 27 |
| Paper & paper products | 22 | 22 | 21 | 20 | -2 | 3.41% | 20 | 0.0661 | 24 |
| Other chemicals & man-made fibres | 23 | 27 | 23 | 24 | 1 | 6.16% | 31 | 0.0648 | 23 |
| Coal mining | 24 | 25 | 28 | 29 | 5 | 9.61% | 36 | 0.0856 | 30 |
| Basic chemicals | 25 | 23 | 26 | 26 | 1 | 7.82% | 34 | 0.1506 | 36 |
| Metal products excluding machinery | 26 | 20 | 19 | 17 | -9 | 1.66% | 7 | 0.0596 | 20 |
| Textiles | 27 | 15 | 15 | 14 | -13 | 0.36% | 2 | 0.0350 | 9 |
| Non-metallic minerals | 28 | 26 | 24 | 22 | -6 | 4.57% | 28 | 0.0680 | 26 |
| Food | 29 | 28 | 27 | 28 | -1 | 4.68% | 29 | 0.0444 | 11 |
| Other mining | 30 | 29 | 29 | 27 | -3 | 2.59% | 11 | 0.0623 | 21 |
| Basic iron & steel | 31 | 30 | 30 | 30 | -1 | 3.96% | 23 | 0.0507 | 13 |
| Gold & uranium ore mining | 32 | 32 | 34 | 34 | 2 | 3.49% | 21 | 0.0375 | 10 |
| Wholesale & retail trade | 33 | 33 | 32 | 33 | 0 | 2.53% | 10 | 0.0238 | 4 |
| Electricity, gas & steam | 34 | 34 | 35 | 35 | 1 | 3.13% | 16 | 0.0284 | 6 |
| Agriculture, forestry & fishing | 35 | 35 | 33 | 32 | -3 | 0.45% | 3 | 0.0127 | 1 |
| Transport & storage | 36 | 36 | 36 | 36 | 0 | 2.74% | 12 | 0.0315 | 7 |
| Finance & insurance | 37 | 37 | 37 | 37 | 0 | 2.87% | 14 | 0.0192 | 2 |
| Community services (incl general | 38 | 38 | 38 | 38 | 0 | 3.82% | 22 | 0.0229 | 3 |
| Total | | | | | | 3.32% | | 0.0214 | |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: high ranking indicates high capital stock*

*Rank of Sectors: Transport Equipment*

Table 4.4 reports the rank of sectors in terms of their stock of Transport Equipment. Again, there are some strong differences between sectors in terms of the strength of investment in Transport Equipment, with resultant changes in the relative level of Transport Equipment available in those sectors. Strong increases in the stock of Transport Equipment on an average annual basis are recorded in Basic iron & steel (+9.12%), Motor vehicles & accessories (+8.60%), Other manufacturing (+8.60%) and Coal mining (+7.10%). A number of other sectors recorded disinvestment of Transport Equipment on average: Agriculture, Forestry & Fishing (-2.22%), Footwear (-1.35%), Other transport equipment producers (-1.11%), Non-metallic minerals (-0.81%), Wearing apparel (-0.56%), Construction (-0.53%) and Electrical machinery (-0.15%). As in the instance of the Building & Construction category, therefore, these strong tendencies toward investment or disinvestment might distort the net investment picture considerably, where the interest is investment in fixed capital stock.

Table 4.4: Sectoral capital stock: Transport Equipment

| | 1970 rank | 1980 rank | 1990 rank | 1997 rank | change in rank 1970-97 | unweight average annual growth 1970-97 | rank unweight average annual growth 1970-97 | st dev unweight average annual growth 1970-97 | rank st dev unweight average annual growth 1970-97 |
|---|---|---|---|---|---|---|---|---|---|
| Leather & leather products | 1 | 1 | 1 | 2 | 1 | 0.49% | 8 | 0.1193 | 20 |
| Other industries | 2 | 6 | 6 | 6 | 4 | 4.92% | 29 | 0.1577 | 31 |
| Footwear | 3 | 2 | 3 | 1 | -2 | -1.35% | 2 | 0.1666 | 32 |
| Professional & scientific equipment | 4 | 3 | 4 | 3 | -1 | 2.21% | 19 | 0.1773 | 33 |
| Glass & glass products | 5 | 5 | 7 | 10 | 5 | 6.42% | 34 | 0.2138 | 36 |
| Tobacco | 6 | 4 | 2 | 4 | -2 | 0.65% | 9 | 0.1905 | 35 |
| Plastic products | 7 | 9 | 13 | 7 | 0 | 2.81% | 22 | 0.1069 | 16 |
| Television, radio & communication equipment | 8 | 10 | 5 | 9 | 1 | 3.48% | 26 | 0.1334 | 27 |
| Basic non-ferrous metals | 9 | 12 | 12 | 14 | 5 | 5.01% | 30 | 0.1839 | 34 |
| Other transport equipment | 10 | 7 | 8 | 5 | -5 | -1.11% | 3 | 0.1379 | 29 |
| Rubber products | 11 | 8 | 9 | 11 | 0 | 1.69% | 17 | 0.0747 | 5 |
| Furniture | 12 | 13 | 10 | 16 | 4 | 4.30% | 27 | 0.1174 | 19 |
| Coal mining | 13 | 17 | 14 | 22 | 9 | 7.10% | 36 | 0.2264 | 37 |
| Wearing apparel | 14 | 11 | 11 | 8 | -6 | -0.56% | 5 | 0.0901 | 10 |
| Printing, publishing & recorded media | 15 | 14 | 15 | 20 | 5 | 4.37% | 28 | 0.1074 | 17 |
| Paper & paper products | 16 | 18 | 18 | 24 | 8 | 5.30% | 32 | 0.0926 | 12 |
| Textiles | 17 | 15 | 16 | 13 | -4 | 0.82% | 10 | 0.0891 | 9 |
| Community services (incl general | 18 | 16 | 17 | 18 | 0 | 2.43% | 21 | 0.0719 | 4 |
| Electrical machinery | 19 | 22 | 21 | 12 | -7 | -0.15% | 7 | 0.1272 | 24 |
| Basic chemicals | 20 | 24 | 26 | 19 | -1 | 3.14% | 25 | 0.1358 | 28 |
| Wood & wood products | 21 | 20 | 20 | 15 | -6 | 1.40% | 13 | 0.1313 | 26 |
| Basic iron & steel | 22 | 31 | 19 | 29 | 7 | 9.12% | 38 | 0.2777 | 38 |
| Motor vehicles, parts & accessories | 23 | 23 | 30 | 34 | 11 | 8.60% | 37 | 0.1223 | 22 |
| Electricity, gas & steam | 24 | 30 | 31 | 30 | 6 | 5.71% | 33 | 0.0832 | 7 |
| Beverages | 25 | 28 | 28 | 28 | 3 | 5.01% | 31 | 0.1097 | 18 |
| Coke & refined petroleum products | 26 | 21 | 25 | 23 | -3 | 1.69% | 16 | 0.1228 | 23 |
| Machinery & equipment | 27 | 27 | 24 | 21 | -6 | 0.96% | 12 | 0.1009 | 15 |
| Other chemicals & man-made fibres | 28 | 19 | 23 | 25 | -3 | 1.46% | 15 | 0.0802 | 6 |
| Non-metallic minerals | 29 | 29 | 22 | 17 | -12 | -0.81% | 4 | 0.1384 | 30 |
| Metal products excluding machinery | 30 | 26 | 27 | 26 | -4 | 1.46% | 14 | 0.0850 | 8 |
| Gold & uranium ore mining | 31 | 25 | 29 | 27 | -4 | 0.96% | 11 | 0.1201 | 21 |
| Other mining | 32 | 32 | 32 | 33 | 1 | 2.93% | 23 | 0.1304 | 25 |
| Food | 33 | 33 | 33 | 32 | -1 | 2.35% | 20 | 0.1005 | 14 |
| Building construction | 34 | 34 | 34 | 31 | -3 | -0.53% | 6 | 0.0923 | 11 |
| Agriculture, forestry & fishing | 35 | 35 | 35 | 35 | 0 | -2.22% | 1 | 0.0596 | 2 |
| Wholesale & retail trade | 36 | 36 | 36 | 36 | 0 | 3.08% | 24 | 0.0600 | 3 |
| Finance & insurance | 37 | 37 | 37 | 37 | 0 | 6.65% | 35 | 0.0939 | 13 |
| Transport & storage | 38 | 38 | 38 | 38 | 0 | 2.07% | 18 | 0.0395 | 1 |
| Total | | | | | | 4.17% | | 0.0421 | |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: high ranking indicates high capital stock.*

It is, therefore, potentially important that any consideration of changes in the capital stock focuses explicitly on the measure of capital stock of Machinery & Equipment since this most directly identifies the category of fixed investment that forms the focus of economic theory. As can be seen in Table 4.5, a number of sectors report high investments in fixed capital stock and high average annual growth rates in capital stock. Glass (+10.02%), Basic non-ferrous metals (+9.28%), Paper (+8.14%), Coal mining (+8.05%), Community, social & personal services (+8.04%), Beverages (+7.00%), Plastics (+6.91%) and Other transport equipment producers (+6.70%) all show strong increases in the stock of physical capital stock over time. On the other hand, two sectors report negative average annual growth rates in physical capital stock: Textiles (-0.19%) and Agriculture, Forestry & Fishing (-0.06%). It is noticeable that a number of sectors that demonstrated strong increases in the other two dimensions of capital stock are considerably less prominent in terms of investment in fixed capital stock as measured by Machinery & Equipment.

Table 4.5: Sectoral capital stock: Machinery and Equipment

| | 1970 rank | 1980 rank | 1990 rank | 1997 rank | change in rank 1970-97 | unweight average annual growth 1970-97 | rank unweight average annual growth 1970-97 | st dev unweight average annual growth 1970-97 | rank st dev unweight average annual growth 1970-97 |
|---|---|---|---|---|---|---|---|---|---|
| Leather & leather products | 1 | 1 | 1 | 4 | 3 | 5.23% | 25 | 0.1286 | 23 |
| Professional & scientific equipment | 2 | 2 | 2 | 1 | -1 | 0.02% | 4 | 0.1105 | 17 |
| Footwear | 3 | 4 | 5 | 5 | 2 | 1.97% | 8 | 0.0868 | 10 |
| Tobacco | 4 | 5 | 3 | 2 | -2 | 0.71% | 5 | 0.1423 | 27 |
| Furniture | 5 | 3 | 7 | 6 | 1 | 5.05% | 23 | 0.1579 | 30 |
| Glass & glass products | 6 | 7 | 9 | 13 | 7 | 10.02% | 38 | 0.2803 | 37 |
| Other industries | 7 | 6 | 6 | 3 | -4 | -0.57% | 1 | 0.1324 | 26 |
| Other transport equipment | 8 | 9 | 4 | 10 | 2 | 6.70% | 31 | 0.2349 | 35 |
| Television, radio & communication equipment | 9 | 10 | 8 | 9 | 0 | 5.06% | 24 | 0.1629 | 31 |
| Wearing apparel | 10 | 11 | 11 | 7 | -3 | 1.28% | 7 | 0.0860 | 9 |
| Wood & wood products | 11 | 8 | 10 | 8 | -3 | 2.25% | 9 | 0.1304 | 24 |
| Community services (incl general | 12 | 17 | 21 | 20 | 8 | 8.04% | 34 | 0.1147 | 19 |
| Plastic products | 13 | 14 | 17 | 18 | 5 | 6.91% | 32 | 0.1154 | 20 |
| Rubber products | 14 | 12 | 12 | 11 | -3 | 3.40% | 15 | 0.1104 | 16 |
| Electrical machinery | 15 | 18 | 14 | 12 | -3 | 2.28% | 11 | 0.1037 | 15 |
| Printing, publishing & recorded media | 16 | 13 | 13 | 17 | 1 | 5.98% | 30 | 0.1754 | 32 |
| Beverages | 17 | 16 | 22 | 23 | 6 | 7.00% | 33 | 0.1165 | 21 |
| Coal mining | 18 | 27 | 28 | 27 | 9 | 8.05% | 35 | 0.1819 | 34 |
| Basic non-ferrous metals | 19 | 15 | 15 | 25 | 6 | 9.28% | 37 | 0.3063 | 38 |
| Machinery & equipment | 20 | 20 | 16 | 14 | -6 | 0.94% | 6 | 0.0965 | 13 |
| Metal products excluding machinery | 21 | 24 | 18 | 16 | -5 | 2.25% | 10 | 0.0871 | 11 |
| Paper & paper products | 22 | 19 | 26 | 28 | 6 | 8.13% | 36 | 0.2610 | 36 |
| Motor vehicles, parts & accessories | 23 | 21 | 24 | 22 | -1 | 3.92% | 17 | 0.1139 | 18 |
| Non-metallic minerals | 24 | 23 | 19 | 19 | -5 | 2.94% | 12 | 0.1517 | 28 |
| Building construction | 25 | 29 | 29 | 24 | -1 | 3.81% | 16 | 0.0967 | 14 |
| Textiles | 26 | 22 | 20 | 15 | -11 | -0.19% | 2 | 0.0838 | 6 |
| Basic chemicals | 27 | 26 | 23 | 21 | -6 | 3.02% | 13 | 0.1760 | 33 |
| Other chemicals & man-made fibres | 28 | 28 | 27 | 26 | -2 | 3.32% | 14 | 0.1182 | 22 |
| Food | 29 | 25 | 25 | 29 | 0 | 4.33% | 19 | 0.0914 | 12 |
| Coke & refined petroleum products | 30 | 30 | 30 | 31 | 1 | 5.95% | 29 | 0.1542 | 29 |
| Other mining | 31 | 32 | 34 | 34 | 3 | 5.92% | 28 | 0.0560 | 4 |
| Gold & uranium ore mining | 32 | 35 | 37 | 32 | 0 | 4.41% | 20 | 0.0850 | 7 |
| Finance & insurance | 33 | 31 | 35 | 36 | 3 | 5.55% | 27 | 0.0502 | 2 |
| Wholesale & retail trade | 34 | 33 | 32 | 33 | -1 | 4.20% | 18 | 0.0560 | 3 |
| Basic iron & steel | 35 | 34 | 31 | 37 | 2 | 5.53% | 26 | 0.1321 | 25 |
| Transport & storage | 36 | 36 | 36 | 35 | -1 | 4.44% | 21 | 0.0477 | 1 |
| Agriculture, forestry & fishing | 37 | 37 | 33 | 30 | -7 | -0.06% | 3 | 0.0828 | 5 |
| Electricity, gas & steam | 38 | 38 | 38 | 38 | 0 | 5.03% | 22 | 0.0855 | 8 |
| Total | | | | | | 2.56% | | 0.0415 | |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: high ranking indicates high capital stock.*

Although it is obvious that the ranking of sectors in terms of the three types of asset types must correlate strongly with the size of the sector in terms of gross and perhaps even net value of production and the data presented in the three tables above does not offer much policy relevance in its own right, it is a necessary step toward a more sophisticated type of descriptive analysis. It has also shown us the relative importance of the three types assets, and for the remainder of our discussion we therefore focus on the Machinery & Equipment measure of the capital stock, above all in order to identify as directly as possible the category of fixed investment.

### *4.3) The Relative Importance of sectors in the use of Machinery & Equipment*

The focus of the present subsection is on the relative use of Machinery & Equipment by South African economic sectors. While this does not provide a measure of the capital intensity of production, it does provide some indication of the distribution of capital across sectors of the South African economy.

The growth in the real stock of capital as measured by Machinery & Equipment for the economy as a whole has shown a sharp downward trend over the 1970-97 period. While the 1970's saw an average[9] growth rate in real capital stock of 7.08%, it can be seen in Table 4.6 that this has declined to 3.77% and 1.4% in the 1980's and 1990's respectively.

However, this aggregate trend inevitably conceals strong sectoral differences. In particular, the most noticeable structural change in the growth of capital to emerge is that manufacturing sectors that traditionally had relatively low growth rates in comparison with other sectors in the economy, during the course of the 1990's have shown the most rapid expansion of their capital stock.

Table 4.5 provides rankings of sectors in terms of capital stock as measured by Machinery & Equipment, for the years 1970, 1980, 1990 and 1997.[10] The main idea behind this table is to examine the importance of each sector relative to the size of fixed capital held by other sectors in the economy. This will be contrasted in the next section with the actual or absolute level of capital stock held in different sectors.

The implication of the evidence is that the relative importance of sectors in the aggregate capital market for machinery & equipment has been subject to considerable change over the 1970-97 time period. Only 4 of 38 sectors show no change in their relative importance as employers of fixed capital in the market, and a number of sectors show very strong changes in their relative importance.

In particular, seven sectors show very dramatic increases in terms of their relative importance as employers of fixed capital:

- Coal Mining (increase in ranking of +9)
- Community, Social and Personal Services (+8)
- Glass & Glass Products (+7)
- Beverages (+6)
- Basic Non-Ferrous Metals (+6), and Paper & Paper Products (+6)
- Plastic Products (+5),

all show a rank improvement of 5 or greater. Four sectors show a very strong relative decline in employment of fixed capital (defined as a fall of 5 or greater in ranking):

- Textiles (-11),
- Agriculture, Forestry & Fishing (-7),
- Basic Chemicals (-6),
- Machinery & Apparatus (-6),
- Fabricated Metals (-5) and
- Other Non-Metallic Minerals (-5).

[9] Computed as an average across all sectors. It is thus weighted for the relative size of capital stock in each of the sectors.
[10] Note that the evidence does not reflect yearly changes, given the use of a few bench-mark time points.

Significantly, it is noticeable that for most of these industries the strongest change in relative importance in the capital market occurs *before* 1990. This suggests that that the changing patterns of relative capital usage in the South African economy are thus likely to be attributable to long term structural factors, rather than to any factor that is associated with policy or circumstantial changes that occurred during the 1990's. In particular, explanations that identify single factors, such as trade liberalisation for instance, as the reason for changing patterns of relative capital usage, are likely to be hard-pressed to provide evidence, given the long run structural patterns of change noted. Only for the Glass & Glass Products and Basic Non-Ferrous Metals sectors does a strong change in relative importance of capital employed emerge after 1990, and can thus possibly be associated with a policy intervention such as trade liberalisation.

Indeed for a number of sectors the likely explanation of changing patterns of relative capital usage is structural adjustment between and within sectors in the economy. For instance, for Coal Mining the strong increase in relative capital usage (+9) is also associated with a strong decrease in relative importance within the South African labour market (not shown here)[11], suggesting that increased capital usage is due either to technological requirements, or to changes in labour market conditions (such as the real wage). For two further sectors, Other Non-Metallic Minerals, Textiles & Knitwear, decreasing relative importance in capital markets is mirrored by strong decreases in their relative importance in employment (not shown here), suggesting a general decline in importance of the sectors in employment within all factor markets. Thus, these sectors appear to be declining in relative importance within the economy as a whole, and have been doing so for a protracted period of time.

The implication is that the changing policy environment of the 1990's, and particular policy interventions such as trade liberalisation in particular, while plausibly contributing to changing patterns of relative capital usage in South Africa, are perhaps not the major and certainly not the sole determinant of changing relative capital usage in the South African economy.

Table 4.6 focuses specifically on the relative growth in capital stock in the different decades in view of the fact that the growth rate of capital stock is subject to very strong fluctuations on an annual basis. For our purposes the 1990s is of particular interest. The ten sectors of the South African economy with the most rapidly growing capital stock in the South African economy in the 1990's were manufacturing sectors. By contrast, the 1980's not only saw a very severe negative impact on numerous manufacturing sectors in terms of the growth of their capital stock, but saw a number of sectors with strong state involvement (Electricity, Gas & Water), or strong mining presence (Gold & Uranium, Coal) amongst the leading investors in machinery & equipment. The 1970's show an even more marked bias toward the strongest growth in capital stock for sectors with a strong mining bias, or heavy state involvement (the ten sectors with the strongest growth rate in capital stock during the course of the 1970's were: Electricity, Gas & Water; Transport, Storage & Communication; Petroleum Refining (including SASOL); Construction; Gold & Uranium; Coal; Diamond Mining; Community, Social & Personal Services; Basic Iron & Steel; and Other Chemicals & Fibres).

[11] For details of labour market developments, see the discussion in Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999a).

The evidence is such as to suggest the plausibility of a bias in the South African capital markets due to the heavy reliance on the mining of primary commodities during earlier phases of development of the economy, and the presence of substantial government-led investment in capital stock of a number of core sectors (Electricity, Gas & Water, Petroleum Refining). The gradual disappearance of a reliance on primary commodities in the South African economy, and reduced state involvement in "strategic" investments appear to have triggered a restructuring of the South African capital market. In particular, sectors whose access to capital might have been limited due to the demand originating from mining and state sectors (both increasing the financial cost of entry into financial capital markets), have shown strong growth in their capital stock during the later decades of our period of review.

Table 4.6: Unweighted average annual growth rates and their rankings: Machinery & Equipment

| | growth 1970s | growth 1980s | growth 1990s | rank 1970s | rank 1980s | rank 1990s |
|---|---|---|---|---|---|---|
| All Economic Activities | 7.08 | 3.77 | 1.40 | | | |
| Professional & scientific equipment | -2.33 | 2.23 | -7.79 | 5 | 17 | 1 |
| Gold & Uranium Ore Mining | 8.04 | 8.94 | -5.39 | 30 | 35 | 2 |
| Other Industries | -2.68 | 2.03 | -4.95 | 4 | 15 | 3 |
| Electricity, Gas & Water | 10.96 | 7.03 | -4.16 | 34 | 34 | 4 |
| Agriculture, Forestry & Fishing | 5.47 | -2.94 | -2.72 | 23 | 4 | 5 |
| Wearing Apparel | 1.32 | 2.34 | -1.36 | 17 | 19 | 6 |
| Construction | 13.48 | -1.11 | -1.08 | 37 | 8 | 7 |
| Machinery | 0.49 | 2.47 | -0.97 | 15 | 20 | 8 |
| Transport, St orage & Commun. | 8.15 | 4.71 | -0.13 | 31 | 27 | 9 |
| Electrical Machine | 5.58 | 0.67 | -0.01 | 24 | 12 | 10 |
| Textiles | -4.43 | 2.5 | 0.8 | 1 | 22 | 11 |
| Footwear | 0.38 | 0.26 | 1.45 | 14 | 10 | 12 |
| Coal Mining | 15.51 | 6.33 | 1.48 | 38 | 32 | 13 |
| Other Chem & Fibre | 7.61 | 0.32 | 2.07 | 29 | 11 | 14 |
| Tobacco | -0.33 | -4.69 | 3.88 | 10 | 2 | 15 |
| Basic Chemicals | 4.24 | 0.85 | 4.08 | 22 | 14 | 16 |
| Petroleum Refined | 11.02 | 2.72 | 4.16 | 35 | 24 | 17 |
| Finance, Insurance, Real Est | 5.72 | 5.86 | 4.9 | 25 | 29 | 18 |
| Paper | -0.68 | 18.3 | 5.05 | 9 | 38 | 19 |
| Furniture | -2.98 | 9.54 | 5.12 | 2 | 36 | 20 |
| Diamond & Other Mining | 10 | 2.48 | 5.55 | 33 | 21 | 21 |
| Wholesale & Retail Trade | 6.68 | 0.74 | 5.66 | 28 | 13 | 22 |
| Fabricated Metals | 4.09 | -2.47 | 5.72 | 21 | 5 | 23 |
| Wood | -2.73 | 2.65 | 5.98 | 3 | 23 | 24 |
| Other N-Metal Minerals | 0.31 | 2.23 | 6.45 | 12 | 17 | 25 |
| Motor Veh & Acces | -1.94 | 6.08 | 7.51 | 6 | 31 | 26 |
| Community, Soc & Per Service | 11.49 | 3.78 | 8.96 | 36 | 26 | 27 |
| Rubber | 0.79 | -0.11 | 9.61 | 16 | 9 | 28 |
| Radio, tv & comm equipm | 6.27 | -1.27 | 9.99 | 26 | 7 | 29 |
| Leather & Tanning | 0.35 | -2.01 | 10.44 | 13 | 6 | 30 |
| Plastics | 3.25 | 6.59 | 10.64 | 20 | 33 | 31 |
| Food | 0.12 | 2.84 | 10.74 | 11 | 25 | 32 |
| Beverages | 3.16 | 5.89 | 12.24 | 19 | 30 | 33 |
| Basic Iron & Steel | 8.38 | -3.52 | 13.58 | 32 | 3 | 34 |
| Publish & Printing | -1.61 | 5.66 | 14.15 | 8 | 28 | 35 |
| Glass | -1.79 | 10.5 | 20.38 | 7 | 37 | 36 |
| Bas N-Ferrous Metals | 2.12 | 2.09 | 25.87 | 18 | 16 | 37 |
| Transport Equipmen | 6.47 | -10.61 | 26.19 | 27 | 1 | 38 |

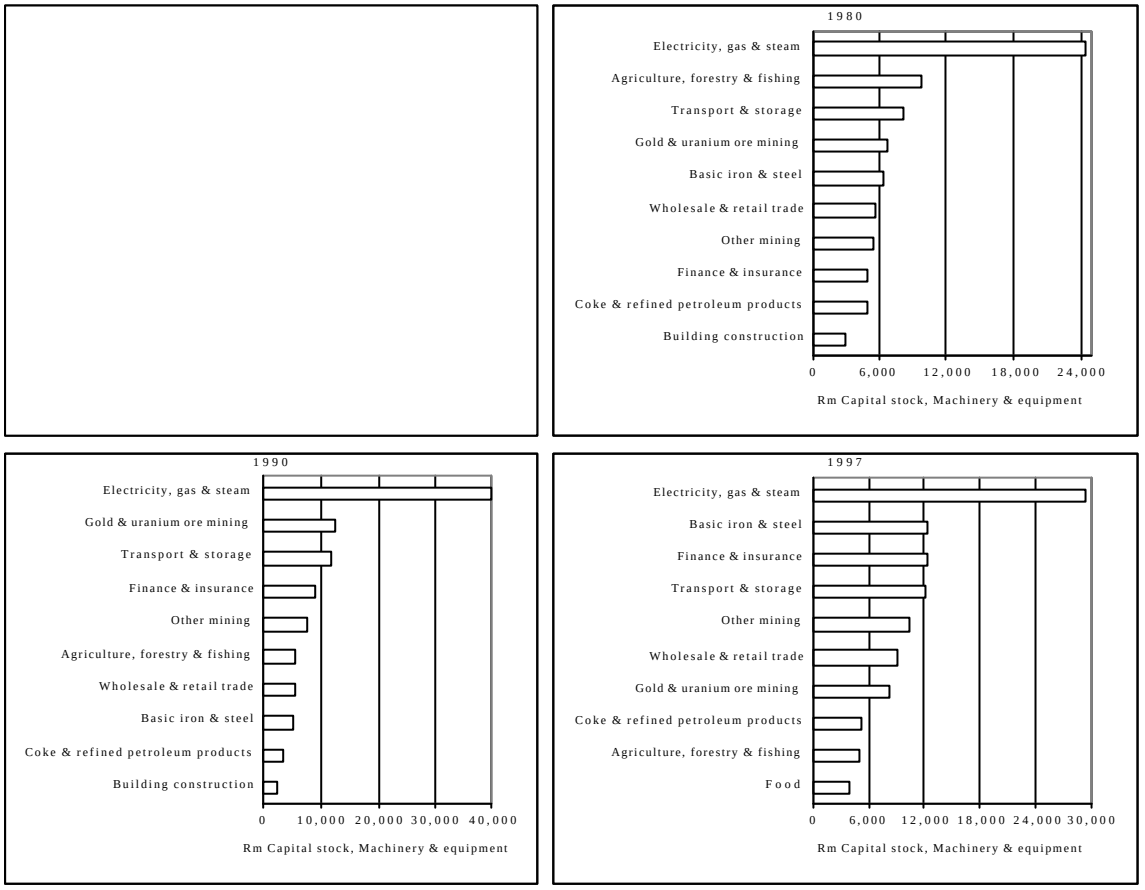
*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: a high rank, indicates a high growth rate.*

The implication of such a line of reasoning (if correct), is that one reason why investment expenditure in South Africa is currently at such low levels is simply that strong growth rates in capital stock are being maintained in sectors with low absolute levels of capital stock. Such sectors may have been prevented from increasing their capital stock from past biases in the economy's capital markets. But over time, if the restructuring of the capital markets occurs in line with new patterns of development, and greater reliance on market forces is allowed to proceed, the absolute volume as well as the proportional increases in manufacturing sector fixed capital stock may well come to raise the aggregate growth rate of the economy's capital stock to more significant levels than are being currently maintained.

***4.4) The importance of sectors in employment of Machinery & Equipment capital stock***

The relative importance of sectors in employing capital does not yet capture their absolute importance as capital users. To provide more detailed information on the absolute level of capital employed by sectors., Figure 4.3 reports the absolute level of Machinery & Equipment employed in each of the top 10 sectors for the comparison years: 1970, 1980, 1990, 1997.

Figure 4.3: Absolute levels of Machinery and equipment employed for selected years (R million 1990 constant prices)




*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b)*

The South African capital market is dominated by a relatively small number of sectors – see the illustration in Figure 4.3 Thus at the comparison years, the top five sectors were:

- In 1970: Electricity, Gas & Water; Agriculture, Forestry & Fishing; Transport, Storage & Communications; Basic Iron & Steel; Wholesale & Retail Trade.
- In 1980: Electricity, Gas & Water; Agriculture, Forestry & Fishing; Transport, Storage & Communications; Gold & Uranium Ore Mining; Basic Iron & Steel.
- In 1990: Electricity, Gas & Water; Gold & Uranium Ore Mining; Transport, Storage & Communications; Finance, Insurance & Real Estate; Diamond Mining.
- In 1997: Electricity, Gas & Water; Basic Iron & Steel; ; Finance, Insurance & Real Estate; Transport, Storage & Communications; Diamond Mining.

Electricity, Gas & Water is consistently the single largest employer of Machinery & Equipment in the South African economy, and its lead over the closest rival was extended through the course of the 1970's and 1980's (with the strongest increase manifested during the 1980's), and only the 1990's has seen a narrowing of the gap.

A second feature of the absolute capital employment figures is that the top five capital-using sectors are generally not manufacturing sectors – the one exception being Basic Iron & Steel.[12] Indeed, a rather surprising feature is the preponderance of service sectors amongst sectors with strong exposure to Machinery & Equipment in the South African economy. By contrast both Gold & Uranium Ore Mining, and Diamond & Other Mining show only intermittent presence amongst the top five strongest users of Machinery & Equipment in the South African economy. While this may be an accurate representation of conditions in the mining sector, an alternative explanation may lie in the fact that a considerable proportion of the mining sectors' capital stock is recorded under the Buildings & Construction category excluded from consideration for the present study. As such, the capital stock figures recorded under Machinery & Equipment for mining sectors may be biased downward should they be considered indicators of fixed capital stock.

The relative importance of sectors as employers of capital in South Africa therefore needs to be tempered by the realisation that in absolute terms, changes in the four to five largest sectors in terms of the stock of Machinery & Equipment employment will have a disproportionately large impact on the level of the aggregate capital stock of the economy. By contrast, strong changes in relative terms in the manufacturing sector will simply not translate into very significant changes in the aggregate stock of Machinery & Equipment in the economy as a whole. Individual manufacturing sectors do not contribute that significantly to the stock of Machinery & Equipment in the economy.

In the previous subsection we noted that evidence on the relative capital usage across economic sectors in the South African economy suggested the presence of long term structural changes in capital markets, rather than changes associated with an altered policy environment through the 1990's. Still, evidence from the absolute level of capital usage as measured by Machinery & Equipment does lend some credence to the possibility that the 1990's and its changed policy environment may have had an impact on capital usage in the South African economy. This is most evident in the declining Machinery & Equipment capital stock in Electricity, Gas & Water, and above all the strong increase in the usage of this category of capital by the Basic Iron & Steel, and Diamond and Other Mining sectors. Given that the period after 1985 saw a sharp decline in the value of the Rand without any recovery post-1990, the implication is that the increased exposure to capital in these sectors took place despite the increasing supply price of capital goods – and one plausible explanation for such changes may be the changing trade dispensation that prevailed during the 1990's.

[12] One important caveat is in order here. This is that our data set treats the manufacturing sector at a relatively disaggregated level, while other sectors (services, mining) are treated at a relatively high level of aggregation. Thus the comparison across sectors is placing the manufacturing sector at a disadvantage. We recognise the problem. However, to our knowledge no more disaggregated data than that employed for this study is publicly available on capital stock in non-manufacturing sectors, and we therefore have no means of improving the accuracy of our comparison.

Given the large preponderance of a small number of sectors in terms of the employment of Machinery & Equipment in the South African economy, we should note that changing conditions particularly in terms of the real cost of capital, and the productivity of capital in those sectors, are likely to carry disproportionate consequences for capital market conditions for other sectors. The Electricity, Gas & Water sector in particular may have had a strong influence in determining a higher price for capital stock (in financial markets) to the South African economy for the 1970-97 period than might have prevailed without the strong state-led expansion in this particular sector. This may have had adverse effects on the investment behaviour of smaller manufacturing sectors.

An examination of the absolute employment of capital stock in the economy by sector, and changes in the absolute levels of employment of capital stock points to the importance of the proportional growth rate in the capital stock by sector. Strong proportional growth rates in Machinery & Equipment could have been maintained by various (or all) economic sectors, without any changes in the ranking of the sector in terms of capital employed.

***4.5) Investment and Real Labour Remuneration***

Factor costs play a critical role in the defining the parameters of investment behaviour. Our study focuses primarily on the capital market. However, some preliminary observations on the labour market are appropriate at this stage. One of the issues that may have importance is the question whether relative factor prices are forcing a switch to capital in place of labour. A first exploration in this direction is provided in Table 4.7 where we show information on the real remuneration per worker (real wage bill/employment) for the relevant sectors as unweighted averages for selected periods.

Table 4.7: Sectoral average wages per worker

| | unweight average annual growth 1970 rank | unweight average annual growth 1980 rank | unweight average annual growth 1990 rank | change in rank 1970-97 | unweight average annual growth 1970s-90s | rank unweight average annual growth 1970s-90s | st dev unweight average annual growth 1970s-90s | rank st dev unweight average annual growth 1970s-90s |
|---|---|---|---|---|---|---|---|---|
| Electricity, gas & steam | 1 | 34 | 26 | -25 | -1.1% | 22 | 9.9% | 30 |
| Basic non-ferrous metals | 2 | 11 | 18 | -16 | -3.2% | 3 | 8.5% | 26 |
| Basic chemicals | 3 | 26 | 14 | -11 | -2.2% | 12 | 7.1% | 19 |
| Other industries | 4 | 8 | 21 | -17 | -3.1% | 6 | 6.1% | 13 |
| Transport & storage | 5 | 31 | 28 | -23 | -0.3% | 25 | 5.5% | 8 |
| Plastic products | 6 | 3 | 8 | -2 | -3.8% | 1 | 8.9% | 27 |
| Basic iron & steel | 7 | 28 | 34 | -27 | -0.1% | 26 | 6.8% | 16 |
| Coal mining | 8 | 36 | 23 | -15 | 1.3% | 34 | 15.3% | 36 |
| Electrical machinery | 9 | 19 | 27 | -18 | -1.4% | 17 | 10.5% | 32 |
| Finance & insurance | 10 | 14 | 5 | 5 | -3.1% | 7 | 4.3% | 4 |
| Motor vehicles, parts & accessories | 11 | 17 | 3 | 8 | -3.2% | 4 | 7.1% | 20 |
| Gold & uranium ore mining | 12 | 38 | 38 | -26 | 4.0% | 38 | 16.6% | 37 |
| Coke & refined petroleum products | 13 | 5 | 22 | -9 | -2.2% | 11 | 9.6% | 29 |
| Television, radio & communication equipment | 14 | 9 | 1 | 13 | -3.5% | 2 | 10.5% | 31 |
| Community services incl govt | 15 | 22 | 12 | 3 | -1.6% | 16 | 1.9% | 1 |
| Beverages | 16 | 13 | 15 | 1 | -1.9% | 15 | 6.0% | 12 |
| Rubber products | 17 | 32 | 31 | -14 | 0.5% | 30 | 5.8% | 10 |
| Paper & paper products | 18 | 1 | 16 | 2 | -3.2% | 5 | 5.8% | 9 |
| Food | 19 | 25 | 19 | 0 | -1.0% | 23 | 4.1% | 3 |
| Leather & leather products | 20 | 4 | 25 | -5 | -2.1% | 13 | 6.4% | 14 |
| Wearing apparel | 21 | 18 | 20 | 1 | -1.2% | 21 | 6.6% | 15 |
| Printing, publishing & recorded media | 22 | 16 | 4 | 18 | -2.4% | 9 | 3.8% | 2 |
| Metal products excluding machinery | 23 | 29 | 7 | 16 | -1.4% | 18 | 6.9% | 17 |
| Glass & glass products | 24 | 27 | 35 | -11 | 0.9% | 31 | 7.7% | 23 |
| Machinery & equipment | 25 | 20 | 10 | 15 | -1.3% | 20 | 6.0% | 11 |
| Wood & wood products | 26 | 12 | 2 | 24 | -2.3% | 10 | 4.9% | 5 |
| Other transport equipment | 27 | 30 | 36 | -9 | 1.1% | 32 | 8.3% | 24 |
| Other mining | 28 | 37 | 30 | -2 | 3.0% | 37 | 21.1% | 38 |
| Footwear | 29 | 7 | 13 | 16 | -1.9% | 14 | 8.4% | 25 |
| Wholesale & retail trade | 30 | 21 | 11 | 19 | -0.7% | 24 | 5.2% | 6 |
| Textiles | 31 | 33 | 37 | -6 | 1.9% | 36 | 7.6% | 22 |
| Other chemicals & man-made fibres | 32 | 10 | 24 | 8 | 0.0% | 27 | 7.0% | 18 |
| Non-metallic minerals | 33 | 23 | 32 | 1 | 0.1% | 28 | 5.4% | 7 |
| Furniture | 34 | 6 | 6 | 28 | -2.7% | 8 | 7.6% | 21 |
| Building construction | 35 | 15 | 29 | 6 | 0.1% | 29 | 9.4% | 28 |
| Agriculture, forestry & fishing | 36 | 24 | 33 | 3 | 1.3% | 33 | 12.8% | 34 |
| Professional & scientific equipment | 37 | 2 | 17 | 20 | -1.4% | 19 | 10.5% | 33 |
| Tobacco | 38 | 35 | 9 | 29 | 1.6% | 35 | 14.2% | 35 |
| Total | | | | | -0.7% | | 4.0% | |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: high ranking indicates high average growth in real wages per worker.*

By comparing the results with our previous tables it can be seen that of the ten sectors with the strongest growth in capital stock, seven experienced negative growth rates in real per labour remuneration (real wage bill/employment) over the 1970-97 period. These sectors are:

Table 4.8: Sectors with high capital stock growth and negative growth in real wage rates

| SIC 5th edition | Sector |
|---|---|
| 305 | Beverages |
| 321-322 | Wood & wood products |
| 323 | Paper & paper products |
| 334 | Basic chemicals |
| 335-336 | Other chemicals & man-made fibres |
| 338 | Plastic products |
| 351 | Basic iron & steel |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b)*

It is thus difficult to argue that for these sectors the reason for strong growth rates in fixed capital stock was the real price of labour relative to capital. Instead, for 70% of the sectors reporting strong growth in capital the growth took place *despite* a falling real cost of labour. One explanation for the growth in capital despite falling real labour cost may be that real labour cost simply did not adequately correct for changes in labour productivity. Thus labour productivity could have declined even more strongly than real labour cost, raising the effective real cost of labour. Our digression into the labour market is therefore concluded by a descriptive

analysis of labour productivity, here defined as GDP at constant prices per worker, i.e., divided by employment. The results are shown in the Table 4.9.

Table 4.9: Growth in sectoral GDP per worker (labour productivity, 1990 constant prices)

| | unweight average annual growth 1970 rank | unweight average annual growth 1980 rank | unweight average annual growth 1990 rank | change in rank 1970-97 | unweight average annual growth 1970s-90s | rank unweight average annual growth 1970s-90s | unweight average annual growth 1970s-90s | rank st dev unweight average annual growth 1970s-90s |
|---|---|---|---|---|---|---|---|---|
| Television, radio & communication equipment | 1 | 36 | 1 | 0 | 0.1% | 6 | 14.2% | 31 |
| Coke & refined petroleum products | 2 | 37 | 8 | -6 | 1.5% | 21 | 23.6% | 38 |
| Gold & uranium ore mining | 3 | 1 | 35 | -32 | -1.7% | 2 | 8.3% | 13 |
| Professional & scientific equipment | 4 | 35 | 13 | -9 | 2.6% | 25 | 18.5% | 36 |
| Basic chemicals | 5 | 15 | 29 | -24 | 0.8% | 9 | 9.8% | 19 |
| Leather & leather products | 6 | 20 | 34 | -28 | 1.7% | 23 | 8.9% | 15 |
| Printing, publishing & recorded media | 7 | 25 | 3 | 4 | -0.1% | 5 | 9.1% | 16 |
| Finance & insurance | 8 | 8 | 9 | -1 | -0.9% | 3 | 2.4% | 2 |
| Other industries | 9 | 38 | 36 | -27 | 6.8% | 37 | 20.9% | 37 |
| Other transport equipment | 10 | 3 | 4 | 6 | -2.6% | 1 | 12.2% | 28 |
| Footwear | 11 | 6 | 14 | -3 | -0.2% | 4 | 7.3% | 9 |
| Tobacco | 12 | 16 | 20 | -8 | 0.9% | 10 | 13.9% | 30 |
| Wholesale & retail trade | 13 | 21 | 21 | -8 | 1.7% | 22 | 4.5% | 5 |
| Electricity, gas & steam | 14 | 28 | 33 | -19 | 3.5% | 31 | 4.4% | 4 |
| Wearing apparel | 15 | 18 | 19 | -4 | 1.2% | 17 | 9.6% | 18 |
| Rubber products | 16 | 22 | 12 | 4 | 1.2% | 18 | 8.3% | 12 |
| Community services incl govt | 17 | 19 | 17 | 0 | 1.2% | 16 | 1.3% | 1 |
| Furniture | 18 | 23 | 5 | 13 | 0.9% | 13 | 10.8% | 23 |
| Textiles | 19 | 13 | 27 | -8 | 1.1% | 15 | 11.7% | 27 |
| Motor vehicles, parts & accessories | 20 | 33 | 2 | 18 | 2.0% | 24 | 17.3% | 34 |
| Non-metallic minerals | 21 | 12 | 28 | -7 | 1.1% | 14 | 7.9% | 11 |
| Basic iron & steel | 22 | 14 | 37 | -15 | 3.4% | 29 | 8.8% | 14 |
| Glass & glass products | 23 | 32 | 22 | 1 | 3.1% | 28 | 10.9% | 25 |
| Other mining | 24 | 29 | 30 | -6 | 3.4% | 30 | 9.4% | 17 |
| Transport & storage | 25 | 26 | 32 | -7 | 3.6% | 32 | 4.4% | 3 |
| Machinery & equipment | 26 | 2 | 24 | 2 | 0.2% | 7 | 14.4% | 32 |
| Building construction | 27 | 5 | 26 | 1 | 0.4% | 8 | 6.7% | 8 |
| Metal products excluding machinery | 28 | 11 | 15 | 13 | 0.9% | 11 | 6.6% | 7 |
| Wood & wood products | 29 | 9 | 6 | 23 | 0.9% | 12 | 7.4% | 10 |
| Beverages | 30 | 30 | 11 | 19 | 2.8% | 27 | 10.4% | 22 |
| Food | 31 | 7 | 23 | 8 | 1.4% | 20 | 4.5% | 6 |
| Agriculture, forestry & fishing | 32 | 31 | 25 | 7 | 4.7% | 34 | 14.9% | 33 |
| Coal mining | 33 | 34 | 31 | 2 | 5.1% | 36 | 12.5% | 29 |
| Plastic products | 34 | 24 | 7 | 27 | 3.7% | 33 | 10.1% | 21 |
| Paper & paper products | 35 | 17 | 18 | 17 | 2.7% | 26 | 9.9% | 20 |
| Electrical machinery | 36 | 4 | 10 | 26 | 1.2% | 19 | 11.7% | 26 |
| Basic non-ferrous metals | 37 | 27 | 38 | -1 | 8.7% | 38 | 17.4% | 35 |
| Other chemicals & man-made fibres | 38 | 10 | 16 | 22 | 5.0% | 35 | 10.8% | 24 |
| Total | | | | | 1.3% | | 1.9% | |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999a), note: high ranking indicates high average growth in labour productivity.*

Again, by comparing the results of Table 4.9 with those presented in Table 4.5 it can be observed that five of those sectors with the highest growth rates in capital stock over the period 1971-1997 had higher than economy-wide average growth in labour productivity (see last row of Table 4.9). These sectors are:

Table 4.10: Sectors with high capital stock growth and above average labour productivity growth

| SIC 5th edition | Sector |
|---|---|
| 305 | Beverages |
| 323 | Paper & paper products |
| 335-336 | Other chemicals & man-made fibres |
| 338 | Plastic products |
| 351 | Basic iron & steel |

*Source: own calculations*

The fact that some of the sectors with the highest growth in capital stock over the period 1970-1997 have experienced negative growth rates in real per labour remuneration and above average growth in labour productivity suggests that real labour cost is an unlikely explanation of the high growth in real capital stock in at least these sectors of the economy. Although exploratory data analysis cannot be conclusive, the finding is

suggestive, and we therefore will return to the question of relative factor prices as a determinant of investment in the econometric analysis of the next main section of this report.

### *4.6) The Investment Rate: decomposition by economic sector*

The analysis so far looked at absolute and relative growth in capital stock and the growing importance of various sectors as employers of capital stock, specifically machinery and equipment. A crucial consideration for South African capital markets is what proportion of total real output is reinvested in productive capacity in the form of Machinery & Equipment. For this purpose we compute the Machinery & Equipment net investment rate as:[13]

$$Investment\ Rate_i = \frac{Net\ Investment^{constant\ prices}_{Machinery\ \&\ Equipment,i}}{Value\ Added_i} \tag{4.1}$$

for each economic sector $i$[14]. Table 4.11 reports decade averages for the net investment rate, together with a ranking of economic sectors in terms of their investment rate.

Table 4.11: Average investment rates for selected periods: Machinery & equipment

| | rate 1979s | rate 1980s | rate 1990s | rank 1970s | rank 1980s | rank 1990s |
|---|---|---|---|---|---|---|
| All Economic Activity | 0.02 | 0.02 | 0.01 | | | |
| Electricity, gas & water | 0.26 | 0.25 | -0.13 | 37 | 36 | 1 |
| Gold & uranium ore mining | 0.02 | 0.05 | -0.04 | 22 | 34 | 2 |
| Agriculture, forestry & fishing | 0.04 | -0.02 | -0.02 | 31 | 2 | 3 |
| Professional & scientific equipment | 0.01 | 0.01 | -0.01 | 15 | 26 | 4 |
| Building construction | 0.04 | -0.01 | -0.01 | 28 | 4 | 5 |
| Other industries | -0.01 | 0.00 | 0.00 | 2 | 18 | 6 |
| Electrical machinery | 0.02 | 0.00 | 0.00 | 24 | 10 | 7 |
| Transport, storage & communication | 0.04 | 0.03 | 0.00 | 29 | 32 | 8 |
| Wearing apparel | 0.01 | 0.00 | 0.00 | 16 | 19 | 9 |
| Machinery & equipment | 0.00 | 0.00 | 0.00 | 7 | 8 | 10 |
| Textiles | -0.01 | 0.01 | 0.00 | 1 | 21 | 11 |
| Footwear | 0.00 | 0.00 | 0.00 | 12 | 17 | 12 |
| Tobacco | 0.00 | 0.00 | 0.00 | 10 | 6 | 13 |
| Furniture | 0.00 | 0.01 | 0.01 | 5 | 25 | 14 |
| Coal mining | 0.04 | 0.03 | 0.01 | 30 | 33 | 15 |
| Wholesale & retail trade | 0.01 | 0.00 | 0.01 | 20 | 16 | 16 |
| Other chemicals & man-made fibres | 0.08 | 0.00 | 0.01 | 35 | 9 | 17 |
| Metal products excluding machinery | 0.01 | 0.00 | 0.01 | 18 | 5 | 18 |
| Wood & wood products | 0.00 | 0.00 | 0.01 | 11 | 20 | 19 |
| Basic chemicals | 0.02 | 0.00 | 0.02 | 23 | 14 | 20 |
| Leather & leather products | 0.00 | 0.00 | 0.02 | 13 | 15 | 21 |
| Finance & insurance | 0.03 | 0.02 | 0.02 | 27 | 30 | 22 |
| Motor vehicles, parts & accessories | 0.00 | 0.01 | 0.02 | 8 | 22 | 23 |
| Television, radio & communication | 0.01 | 0.00 | 0.03 | 21 | 13 | 24 |
| Paper & paper products | 0.01 | 0.06 | 0.03 | 17 | 35 | 25 |
| Non-metallic minerals | 0.00 | 0.00 | 0.03 | 6 | 11 | 26 |
| Printing, publishing & recorded media | 0.00 | 0.01 | 0.04 | 3 | 24 | 27 |
| Rubber products | 0.01 | 0.00 | 0.04 | 14 | 12 | 28 |
| Plastic products | 0.03 | 0.02 | 0.05 | 26 | 31 | 29 |
| Food | 0.00 | 0.01 | 0.05 | 9 | 23 | 30 |
| Other mining | 0.07 | 0.02 | 0.06 | 33 | 28 | 31 |
| Beverages | 0.02 | 0.02 | 0.07 | 25 | 27 | 32 |
| Coke & refined petroleum products | 0.21 | 0.29 | 0.08 | 36 | 37 | 33 |
| Glass & glass products | 0.00 | 0.02 | 0.08 | 4 | 29 | 34 |
| Other transport equipment | 0.01 | -0.01 | 0.09 | 19 | 3 | 35 |
| Basic non-ferrous metals | 0.06 | 0.00 | 0.13 | 32 | 7 | 36 |
| Basic iron & steel | 0.07 | -0.04 | 0.16 | 34 | 1 | 37 |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: high rank indicates high investment rate*

[13] Net investment is gross investment corrected for depreciation.

[14] One limitation we face is that the data currently is not yet consistently available by category for both RGDP and Real Net Investment for all South African economic sectors. This means that consistent investment rate ratios were computable for only 38 sectors in the economy.

We note immediately that the investment rate evidence for the economy as a whole confirms the pessimistic evidence gained from the growth in capital stock data, and if anything, darkens the picture yet further. For the economy as a whole the investment rate throughout the 1970-97 period has been poor, remaining at 2% throughout the 1970's and 1980's, and declining yet further to 1% during the course of the 1990's[15].

But as for the growth in the aggregate capital stock, the aggregate picture strongly obscures strong sectoral differences, and there is evidence that the 1990's have begun to see a restructuring of the South African economy in response to a declining primary commodity reliance in the economy as a whole, and perhaps reduced levels of distortion emerging from government-led investment projects.

As for the growth in the capital stock, what is noticeable is the emergence during the course of the 1990's of the manufacturing sector as leader in investment rates in a number of its sub-sectors. Not surprisingly, a number of the sectors that feature in the top-ten ranking in terms of growth in the Machinery & Equipment capital stock measure, also emerge as sectors with high investment rates.[16] Symmetrically, a number of mining sectors (see for instance Gold & Uranium Ore), and sectors with strong state-led investment (see for instance Electricity, Gas & Water) show strong declines in their investment rates during the course of the 1990's.

Indeed, for a number of manufacturing sectors, the average investment rate in Machinery & Equipment, has been in excess of 6% per annum, in some cases substantially so. Thus, Beverages (7%), Coke & refined petroleum products (8%), Glass & glass products (8%), Other transport equipment (9%), Basic non-ferrous metals (13%), Basic iron & steel (16%) have all maintained very healthy investment rates throughout the course of the 1990's. By contrast the 1980's proved a period of exceptionally low investment rates, particularly for the manufacturing sectors.

Once again, therefore, the evidence is such as to suggest the plausibility of a distortion in the South African capital markets due to the heavy reliance on the mining of primary commodities during earlier phases of development of the South African economy, and the presence of substantial government-led investment in capital stock in a number of core sectors (Electricity, Gas & Water, Petroleum Refining). The gradual disappearance of a reliance on primary commodities in the South African economy, and reduced state involvement in "strategic" investments has at least plausibly triggered a restructuring of the South African capital market. In particular, sectors whose access to capital might have been limited due to the demand emerging from mining and state sectors (both increasing the financial cost of entry into financial capital markets), have shown strong growth in their capital stock.

The implication is that the 1990's, with their greater reliance on market forces and a decreased reliance on state led investment, are leading to a restructuring of the South African capital markets. Since restructuring of capital markets inevitably takes time to accomplish, such a process is likely to be in its early phases.

[15] By way of a final reminder, in case these rates look low. Recall that our investment rate is computed purely for the Machinery & Equipment component of capital stock, not total capital stock.
[16] The sectors that are exceptional are Coke & refined petroleum products – but this may be due to a reclassification of the sector – as it was previously classed as the Refined petroleum sector. Also, Other Mining maintains a higher investment rate ranking, than it does a growth in real capital stock ranking.

As for the growth in real capital stock therefore, the encouraging implication of such a line of interpretation (if correct), is that one reason why investment expenditure in South Africa is currently at such low levels is simply that strong growth rates in capital stock are being maintained in sectors with low absolute levels of capital stock. Such sectors may have been prevented from increasing their capital stock due to past distortions in the economy's capital markets. But over time, if the restructuring of the capital markets in line with new patterns of development, and greater reliance on market forces is allowed to proceed, the absolute volume as well as the proportional increases in manufacturing sector capital stock may well come to raise the aggregate growth rate of the economy's capital stock to more reassuring levels than are being currently maintained.

### *4.7) Volatility of Investment Rates and Growth Rates of the Real Capital Stock*

It was pointed out at the outset that one of the most important determinants of investment behaviour is uncertainty amongst private investors about the consistency of government policies, social unrest and others. This section is a prelude to the next phase in the project, it attempts simply to look at fluctuations in South African investment rates.

Table 4.12: Investment rate standard deviations: Machinery & equipment

| | stand dev 1979s | stand dev 1980s | stand dev 1990s | rank 1970s | rank 1980s | rank 1990s |
|---|---|---|---|---|---|---|
| Average | 0.06 | 0.06 | 0.05 | | | |
| Machinery & equipment | 0.00 | 0.02 | 0.01 | 1 | 9 | 1 |
| Furniture | 0.01 | 0.02 | 0.02 | 2 | 13 | 13 |
| Wholesale & retail trade | 0.01 | 0.01 | 0.01 | 3 | 3 | 3 |
| Footwear | 0.01 | 0.01 | 0.02 | 4 | 2 | 11 |
| Metal products excluding machinery | 0.01 | 0.01 | 0.02 | 5 | 7 | 6 |
| Leather & leather products | 0.01 | 0.02 | 0.03 | 6 | 10 | 14 |
| Textiles | 0.01 | 0.02 | 0.04 | 7 | 18 | 19 |
| Tobacco | 0.01 | 0.01 | 0.04 | 8 | 4 | 21 |
| Gold & uranium ore mining | 0.02 | 0.03 | 0.02 | 9 | 19 | 8 |
| Transport, storage & communication | 0.02 | 0.02 | 0.02 | 10 | 11 | 7 |
| Glass & glass products | 0.02 | 0.06 | 0.16 | 11 | 28 | 35 |
| Building construction | 0.02 | 0.02 | 0.01 | 12 | 14 | 2 |
| Wearing apparel | 0.02 | 0.01 | 0.01 | 13 | 5 | 4 |
| Other industries | 0.02 | 0.02 | 0.02 | 14 | 12 | 10 |
| Motor vehicles, parts & accessories | 0.03 | 0.04 | 0.04 | 15 | 24 | 22 |
| Other transport equipment | 0.03 | 0.01 | 0.09 | 16 | 1 | 33 |
| Finance & insurance | 0.03 | 0.01 | 0.02 | 17 | 8 | 9 |
| Electrical machinery | 0.03 | 0.01 | 0.03 | 18 | 6 | 15 |
| Printing, publishing & recorded media | 0.03 | 0.04 | 0.06 | 19 | 23 | 28 |
| Food | 0.03 | 0.02 | 0.04 | 20 | 16 | 23 |
| Other mining | 0.03 | 0.04 | 0.04 | 21 | 26 | 20 |
| Agriculture, forestry & fishing | 0.04 | 0.08 | 0.03 | 22 | 30 | 16 |
| Paper & paper products | 0.04 | 0.19 | 0.09 | 23 | 35 | 32 |
| Wood & wood products | 0.04 | 0.02 | 0.02 | 24 | 17 | 12 |
| Beverages | 0.05 | 0.04 | 0.06 | 25 | 22 | 29 |
| Television, radio & communication | 0.06 | 0.02 | 0.05 | 26 | 15 | 24 |
| Non-metallic minerals | 0.06 | 0.08 | 0.05 | 27 | 31 | 25 |
| Rubber products | 0.06 | 0.03 | 0.04 | 28 | 21 | 18 |
| Professional & scientific equipment | 0.06 | 0.03 | 0.02 | 29 | 20 | 5 |
| Coal mining | 0.07 | 0.04 | 0.05 | 30 | 25 | 26 |
| Plastic products | 0.07 | 0.04 | 0.06 | 31 | 27 | 30 |
| Other chemicals & man-made fibres | 0.13 | 0.08 | 0.03 | 32 | 32 | 17 |
| Basic chemicals | 0.13 | 0.09 | 0.06 | 33 | 33 | 27 |
| Basic non-ferrous metals | 0.13 | 0.10 | 0.18 | 34 | 34 | 37 |
| Basic iron & steel | 0.16 | 0.06 | 0.15 | 35 | 29 | 34 |
| Electricity, gas & water | 0.18 | 0.23 | 0.08 | 36 | 36 | 31 |
| Coke & refined petroleum products | 0.35 | 0.76 | 0.18 | 37 | 37 | 36 |
| Total GDP | 0.01 | 0.02 | 0.02 | | | |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: high rank indicates high investment rate*

Investment rates are frequently argued to be very sensitive to the confidence of investors. Since investment projects are typically such that they have long gestation periods, with pay-offs being realised at time points in

the future which on occasion are very remote, the impact of expectations of what the future will bring becomes particularly important in the determination of investment decisions.

Table 4.12 reports the standard deviations of the investment rate in Machinery & Equipment on a decade average basis for the 1970's, 1980's and 1990's. A number of sectors show marked increases in the volatility of their investment rates relative to other sectors. In particular, Furniture, Textiles, Glass & glass products, and Paper & paper products all show a marked increase in the volatility of their investment rates during the 1980's and 1990's relative to the 1970's, while Other transport equipment experiences increased volatility of its investment rate during the 1990's.

However, only two of these sectors, Glass & glass products, and Other transport equipment are amongst the sectors with strong investment rates during the 1990's. Thus, it does not appear as if the improvement in investment rates amongst manufacturing industries we have noted for the 1990's has been achieved at the cost of higher volatility in investment rates. Indeed, the correlation between the decade average investment rate and the average decade standard deviation of the investment rate declines as we move from the 1970's and 1980's into the 1990's. While the correlation is 0.82 and 0.85 for the 1970's and 1980's respectively, the correlation declines to 0.63 in the 1990's, suggesting that sectors that had high investment rates were less likely to have volatile investment rates during the 1990's than during the preceding decades.

Moreover, the strongest increase in volatility is associated with the increased political uncertainty of the 1980's, rather than the arrival of the 1990's. For the economy as a whole the volatility of the investment rate declined from the levels maintained fairly consistently during the course of the 1970's and 1980's. This suggests that for South Africa risk factors that intruded from the political arena may well have played a significant role in the determination of at least the volatility and perhaps the level of investment expenditure. While this will form part of the subsequent econometric investigation into the determinants of investment expenditure in South Africa, we note that certainly for aggregate investment, and for capital flight there exists strong empirical evidence suggesting that political risk factors are of importance to the South African economy.[17]

We also note that for a number of sectors the volatility of the investment rate decreased substantially during the 1990's relative to other sectors (Agriculture, Forestry & Fishing, Construction, Gold & Uranium Ore Mining, Other Chemicals & Man-Made Fibres, Professional & Scientific Equipment). Table 4.13 reports the standard deviations of the growth rate in real Machinery & Equipment on a decade average basis for the 1970's, 1980's and 1990's.

[17] See Fedderke and Liu (1999), and Fedderke, De Kadt & Luiz (1999c).

Table 4.13: Standard Deviations of Growth Rate in Real Stock: Machinery & Equipment

| | stand dev 1979s | stand dev 1980s | stand dev 1990s | rank 1970s | rank 1980s | rank 1990s |
|---|---|---|---|---|---|---|
| Textiles | 3.58 | 9.30 | 10.00 | 1 | 22 | 22 |
| Transport, Storage & Commun. | 4.24 | 3.15 | 3.07 | 2 | 1 | 5 |
| Furniture | 4.65 | 20.93 | 15.08 | 3 | 37 | 31 |
| Agriculture, Forest. & Fish. | 5.02 | 9.15 | 7.66 | 4 | 21 | 14 |
| Diamond & Other Mining | 5.18 | 4.71 | 4.32 | 5 | 6 | 6 |
| Machinery | 5.61 | 13.15 | 8.91 | 6 | 31 | 18 |
| Manufacturing+AJ45 | 5.64 | 7.76 | 6.55 | 7 | 18 | 11 |
| Mining & Quarrying | 5.73 | 4.18 | 1.74 | 8 | 5 | 1 |
| Wholesale & Retail Trade | 6.02 | 4.17 | 5.01 | 9 | 4 | 8 |
| Gold & Uranium Ore Mining | 6.46 | 6.73 | 2.46 | 10 | 11 | 4 |
| Finance, Insurance, Real Est | 6.68 | 4.07 | 4.53 | 11 | 3 | 7 |
| Fabricated Metals | 6.90 | 8.83 | 8.76 | 12 | 20 | 17 |
| Electricity, Gas & Water | 7.31 | 6.68 | 2.31 | 13 | 10 | 3 |
| Other Maf & Recyc | 7.71 | 12.03 | 18.91 | 14 | 28 | 34 |
| Paper | 8.38 | 39.00 | 15.29 | 15 | 40 | 32 |
| Footwear | 8.74 | 6.79 | 11.43 | 16 | 12 | 26 |
| Leather & Tanning | 8.89 | 11.24 | 16.07 | 17 | 24 | 33 |
| Food | 9.05 | 7.46 | 8.52 | 18 | 16 | 16 |
| Motor Veh & Acces | 9.39 | 12.67 | 10.45 | 19 | 30 | 23 |
| Glass | 9.42 | 24.76 | 41.54 | 20 | 38 | 40 |
| Wearing Apparel | 9.59 | 7.15 | 9.71 | 21 | 14 | 21 |
| Beverages | 11.14 | 12.04 | 11.14 | 22 | 29 | 24 |
| Construction | 11.16 | 3.86 | 1.76 | 23 | 2 | 2 |
| Instruments | 11.38 | 11.52 | 8.22 | 24 | 26 | 15 |
| Bas N-Ferrous Metals | 11.38 | 35.65 | 35.35 | 25 | 39 | 39 |
| Plastics | 11.54 | 10.61 | 12.82 | 26 | 23 | 28 |
| Electrical Machine | 11.59 | 5.95 | 13.28 | 27 | 9 | 29 |
| Publish & Printing | 11.92 | 15.80 | 22.51 | 28 | 34 | 36 |
| Rubber | 12.04 | 11.38 | 7.10 | 29 | 25 | 13 |
| Tobacco | 13.11 | 7.18 | 20.84 | 30 | 15 | 35 |
| Other N-Metal Minerals | 13.39 | 19.03 | 12.65 | 31 | 36 | 27 |
| Wood | 13.89 | 14.64 | 9.23 | 32 | 33 | 19 |
| Radio, tv & comm equipm | 13.92 | 6.94 | 24.70 | 33 | 13 | 37 |
| Other Chem & Fibre | 15.04 | 11.94 | 6.21 | 34 | 27 | 9 |
| Basic Iron & Steel | 15.54 | 5.92 | 11.20 | 35 | 8 | 25 |
| Transport Equipmen | 15.60 | 4.91 | 29.16 | 36 | 7 | 38 |
| Community, Soc & Per Service | 16.91 | 7.59 | 6.70 | 37 | 17 | 12 |
| Petroleum Refined | 16.99 | 17.79 | 9.69 | 38 | 35 | 20 |
| Basic Chemicals | 24.90 | 13.67 | 13.81 | 39 | 32 | 30 |
| Coal Mining | 29.18 | 8.13 | 6.40 | 40 | 19 | 10 |
| All Economic Activities | 2.24 | 4.72 | 3.39 | | | |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: high rank indicates high volatility*

Again, the evidence suggests a relatively wide-spread increase in the volatility of the growth rate in capital after the 1970's, with substantial increases in volatility for Textiles & Knit-wear, Furniture, Agriculture, Forestry & Fishing, and Machinery & Apparatus, Other Manufacturing & Recycling, Paper and Basic Non-ferrous Metals. However, of those sectors where volatility in the growth rate of the capital stock increased during the 1990's,[18] only one was one of the sectors to experience strong growth in its real capital stock in Machinery & Equipment – again suggesting that the improvement in investment performance in the manufacturing sector during the course of the 1990's has not been traded off at the expense of increased volatility in investment. For at least some sectors the 1990's have seen a significant decline in the volatility of investment in real capital: Instruments, Rubber, Wood, Other Chemicals & Fibres, Petroleum Refining, and Machinery & Apparatus all report decreased volatility of growth rates in their real capital stock of Machinery & Equipment.

The possibility of a structural break in capital accumulation during the 1990's, to which our earlier evidence alluded, does not appear to be translating into a greater volatility of investment. For the economy as a whole the standard deviation of the growth rate of the real stock of Machinery & Equipment declines from 4.72 during the 1980's to 3.39 during the 1990's. Similarly, the standard deviation of the investment rate in Machinery and Equipment, while it does not show a decline from that of the 1980's during the 1990's for the economy as a whole (it remains at 0.02), at least does not show evidence of an increase in the volatility of the investment rate.

Therefore, a structural break in investment behaviour during the 1990's, if present, has not manifested itself in greater volatility of investment – but rather in a different distribution of investment across sectors, and in a different level of investment expenditure in sectors.

***4.8) The Real Cost of Capital***

In terms of economic analysis it is not possible to separate changes of quantity of any good, including capital stock, from changes in its price. As a consequence, we now turn to the issue of the real cost of capital, and its potential impact on changing investment ratios across South Africa's economic sectors. For the purposes of the present analysis, we define the user cost of capital as:

$$uc = (i - \pi) + \delta + \tau \qquad (4.2)$$

where

$i$ = the nominal interest rate,

$\pi$ = the inflation rate,

$\delta$ = the depreciation rate on capital stock (defined as Machinery & Equipment),

$\tau$ = denotes the corporate tax rate.

Ideally, $\tau$ should be defined as the net real effective tax rate faced by each sector, such that the tax rate reflects the impact of any tax exemptions, breaks, and subsidies faced by the economic sector. Unfortunately, for South Africa such data is not readily available, particularly since tax exemptions and subsidies are frequently defined on highly disaggregated definitions of capital stock. As a consequence, we compute user cost of capital on the basis of the published aggregate corporate tax rate[19].

The user cost of capital can also be defined in terms of a number of different definitions of the interest rate. For the purposes of the current study, we employ yields on long term government bonds (with more that 10 years to maturity). Nevertheless, we examined the sensitivity of the definition of the user cost of capital to alternative definitions of the interest rate. Table 4.14 reports the correlation coefficients between the alternative computations of the user cost of capital, based on the following interest rates:

- Long term government bond yields: >10 years to maturity
- Medium-term government bond yields: either 3-5 or 5-10 years to maturity
- Short-term government bond yields: 0-3 years to maturity
- Yields on Eskom Bonds
- Yields on Private Sector Bonds

[18] Footwear, Electrical machinery, Tobacco, Radio, TV & Communications Equipment, and Transport Equipment.
[19] While we are constrained by data limitations in this regard, we also suggest that a future topic of research in South Africa might usefully examine the tax component of the user cost of capital in greater detail, in order to develop more accurate real user cost of capital time series.

Table 4.14: Correlation coefficients amongst altemative measures of capital stock

| | Government Bonds: 0-3 years | Government Bonds: 3-5years | Government Bonds: 5-10 years | Government Bonds: over 10 years | Eskom |
|---|---|---|---|---|---|
| Government Bonds: 0-3 years | 1 | | | | |
| Government Bonds: 3-5years | 0.86 | 1 | | | |
| Government Bonds: 5-10 years | 0.99 | 0.87 | 1 | | |
| Government Bonds: over 10 years | 0.98 | 0.86 | 0.998 | 1 | |
| Eskom | 0.85 | 0.72 | 0.86 | 0.86 | 1 |
| Loan stock | 0.90 | 0.76 | 0.94 | 0.95 | 0.77 |

Source: *Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b)*

As is evident from the correlation coefficients, the use of the alternative measures of the interest rate does not generate strongly divergent computations of the user cost of capital. Our choice of the long run government bond yield is driven by the consideration that government directed investment expenditure during the course of the 1970's and 1980's potentially played a dominant role in South African capital markets, as noted in the preceding analysis.

***4.9) Relative Real Cost of Capital by Economic Sector***

In contrast with capital usage, relative real user cost of capital by economic sector shows greater stability over the full 1970-97 period. The correlation between the rank of economic sectors in terms of user cost of capital in 1970 and 1997 is +0.95, suggesting a high degree of stability of relative user costs across sectors over time. Given that two of the three components of the user cost of capital are provided by aggregate magnitudes which are invariant between sectors (the real interest rate, and the corporate tax rate), and only the depreciation rate is sector specific, this is perhaps not surprising.

An immediate implication of this observation is that changes in the user cost of capital are perhaps unlikely to account for changing relative capital usage between sectors, since the relative cost of capital does not vary sufficiently to account for the changing patterns of capital employment across sectors.

In Table 4.15 we report the rank of economic sectors in terms of the real user cost of capital. Very few sectors demonstrate strong increases in the user cost of capital relative to other sectors in the economy. The only exceptions are Agriculture, Forestry & Fishing (+8), Construction (+8), Instruments (+6), and Petroleum Refined (+5). These changes are hardly surprising, given the decrease in subsidies to the agricultural sector after 1980, and falling state-led investment in strategic petroleum production after the 1980's.

Similarly, few sectors show a strong decrease in the relative real user cost of capital in the South African economy. Only for Food (-5), Leather & Tanning (-5), Tobacco (-5) and Transport Equipment (-6) is evidence of strong decrease in the relative cost of capital at all compelling. On the other hand, it is noticeable that for all these sectors the growth rate of the capital stock during the course of the 1990's was relatively high. Thus for Transport Equipment (+26.19%), Leather & Tanning (+10.44%), Food (10.74%) and Tobacco (3.88%) the average annual growth rate in real capital stock as measured by Machinery & Equipment is always comfortably positive, and in the case of some of the sectors very substantially so.

Table 4.15: Real user cost of capital: machinery & equipment

| | cost ratio 1970s | cost ratio 1980s | cost ratio 1990s | rank 1970s | rank 1980s | rank 1990s |
|---|---|---|---|---|---|---|
| Diamond & Other Mining | 0.52 | 0.53 | 0.53 | 1 | 2 | 1 |
| Gold & Uranium Ore Mining | 0.54 | 0.51 | 0.56 | 2 | 1 | 2 |
| All Economic Activities | 0.55 | 0.55 | 0.56 | 3 | 4 | 3 |
| Electricity, Gas & Water | 0.55 | 0.55 | 0.60 | 4 | 5 | 7 |
| Mining & Quarrying | 0.56 | 0.55 | 0.57 | 5 | 6 | 6 |
| Community, Soc & Per Service | 0.57 | 0.60 | 0.57 | 6 | 8 | 5 |
| Transport, Storage & Commun | 0.57 | 0.58 | 0.61 | 7 | 7 | 8 |
| Coal Mining | 0.58 | 0.54 | 0.57 | 8 | 3 | 4 |
| Manufacturing | 0.61 | 0.63 | 0.62 | 9 | 10 | 9 |
| Finance, Insurance, Real Est | 0.62 | 0.63 | 0.63 | 10 | 9 | 11 |
| Basic Iron & Steel | 0.62 | 0.69 | 0.63 | 11 | 14 | 10 |
| Other Chem & Fibre | 0.63 | 0.65 | 0.67 | 12 | 11 | 14 |
| Radio, tv & comm equipm | 0.65 | 0.71 | 0.69 | 13 | 22 | 17 |
| Construction | 0.65 | 0.70 | 0.70 | 14 | 17 | 22 |
| Wholesale & Retail Trade | 0.66 | 0.68 | 0.68 | 15 | 13 | 16 |
| Petroleum Refined | 0.66 | 0.67 | 0.70 | 16 | 12 | 21 |
| Footwear | 0.66 | 0.70 | 0.66 | 17 | 19 | 13 |
| Wood | 0.66 | 0.69 | 0.66 | 18 | 15 | 12 |
| Agriculture, Forest. & Fish. | 0.67 | 0.71 | 0.72 | 19 | 21 | 27 |
| Tobacco | 0.67 | 0.70 | 0.67 | 20 | 18 | 15 |
| Machinery | 0.68 | 0.70 | 0.70 | 21 | 20 | 19 |
| Electrical Machine | 0.68 | 0.74 | 0.73 | 22 | 25 | 29 |
| Furniture | 0.69 | 0.69 | 0.71 | 23 | 16 | 24 |
| Transport Equipmen | 0.69 | 0.79 | 0.69 | 24 | 35 | 18 |
| Leather & Tanning | 0.71 | 0.74 | 0.70 | 25 | 27 | 20 |
| Wearing Apparel | 0.71 | 0.74 | 0.73 | 26 | 26 | 28 |
| Other Maf & Recyc | 0.71 | 0.72 | 0.71 | 27 | 23 | 26 |
| Food | 0.72 | 0.75 | 0.70 | 28 | 28 | 23 |
| Motor Veh & Acces | 0.72 | 0.74 | 0.71 | 29 | 24 | 25 |
| Fabricated Metals | 0.73 | 0.79 | 0.74 | 30 | 34 | 31 |
| Beverages | 0.74 | 0.78 | 0.74 | 31 | 32 | 30 |
| Basic Chemicals | 0.75 | 0.77 | 0.76 | 32 | 30 | 36 |
| Paper | 0.75 | 0.75 | 0.76 | 33 | 29 | 33 |
| Instruments | 0.76 | 0.77 | 0.79 | 34 | 31 | 40 |
| Bas N-Ferrous Metals | 0.76 | 0.82 | 0.75 | 35 | 40 | 32 |
| Plastics | 0.76 | 0.80 | 0.76 | 36 | 37 | 34 |
| Textiles | 0.77 | 0.78 | 0.76 | 37 | 33 | 35 |
| Other N-Metal Minerals | 0.78 | 0.81 | 0.80 | 38 | 39 | 41 |
| Publish & Printing | 0.79 | 0.81 | 0.77 | 39 | 38 | 37 |
| Glass | 0.79 | 0.80 | 0.78 | 40 | 36 | 38 |
| Rubber | 0.80 | 0.85 | 0.79 | 41 | 41 | 39 |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: high rank indicates high real user cost*

The argument of preceding sections that the 1970's and 1980's heavy state directed investment may have distorted the user cost of capital for other sectors in the economy, does gain some credence from this evidence, particularly for sectors of the economy that show the strongest growth rates in the real capital stock.

While the current descriptive context does not readily allow for generalisation, there is some evidence to suggest that the user cost of capital has formed a barrier to investment in the past. The correlation between the average real user cost of capital per sector for the 1970's on the one hand, and the average investment rate for the 1970's and the average proportional growth rate in the real capital stock per sector in the 1970's on the other hand is –0.45 and –0.71 respectively. Thus the higher the user cost of capital, the greater the likelihood that the investment rate and the growth rate in real capital stock would be low. Yet, through the course of the 1980's the two correlations were –0.35 and –0.17, and in the 1990's they rose further to +0.20 and +0.24. The implication appears to be that the user cost of capital formed a significant constraint on investment in real capital stock during the course of the 1970's, but that the severity of this constraint declined during the course of the 1980's and 1990's. It could therefore be argued that the state in its effort to direct investment in South Africa it may have raised the user cost of capital, and that the steady withdrawal of the state from the capital markets and increased reliance on market forces over time may have lowered such distortions. Again, the significance of the real user cost of capital as a determinant of investment during the 1970-97 on a sectoral basis will be subjected

to more detailed econometric investigation in a following section. Suffice it to say that the presence of a link is at least plausible on the basis of the current evidence.

There is an another perhaps complementary interpretation, however. The negative association between magnitude and cost of investment noted for the 1970's is in line with economic theory, while the disappearance of this negative association is a reflection of the negative sentiment generated by the increased levels of political uncertainty that has characterised the 1980's, and the political transition of the 1990's. The importance of the real user costs of capital as an explanatory variable of investment behaviour may to some degree have been eroded by the political uncertainty factor.

### *4.10) Absolute Real Cost of Capital by Economic Sector*

As mentioned above, relative real user cost of capital sheds little light on the absolute magnitude of the user cost of capital in each sector. Two immediate observations emerge from the detailed evidence (not shown here).[20]

- Firstly, the variation between the highest real user cost of capital and the smallest user cost of capital is not as large as the variation of the absolute capital stock of the economy.
- Secondly, changes in the real user cost of capital have occurred primarily for sectors facing the highest real user cost of capital. To a large degree, low real user cost of capital can be found in the same sectors across the period of review.

But there is a third implication that is perhaps of interest in the present context. The ratio of the highest real user cost of capital to the lowest real user cost of capital changes from 1.5:1 in 1970, to 1.77:1 in 1980, 1.73:1 in 1990, and 1.62:1 in 1997**.** This may help to explain the strong negative correlation between the user cost of capital and investment rates during the course of the 1970's, and the subsequent declining strength of the correlation and ultimate change of sign in the correlation in the 1990's. In effect, the widening differential between sectors facing the highest real user cost and that facing the lowest during the course of the 1970's may explain the importance of the user cost of capital as a potential determinant of investment. By contrast, the subsequent narrowing differential between real user costs of capital between sectors may have allowed other factors (such as expectations and political uncertainty) to begin playing an increasing role in the determination of investment activity in the South African economy.

### *4.11) Links between the Real Cost of Capital and Capital Usage*

While we have already shown correlations coefficients between the real user cost of capital and the two alternative measures of investment examined in this report, i.e., the growth in real capital stock and the investment rate, in this subsection we examine this link somewhat more systematically on a sectoral basis. In Table 4.16 we report correlations coefficients between real user cost of capital and the investment rate, and the growth rate of the real capital stock of each sector, over the full 1970-97 period.

[20] For full details of this evidence see the discussion in Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b).

Table 4.16: Correlations: Investment Rate and Real Growth in Capital vs Real User Cost of Capital

| | User Cost vs Investment Rate | User Cost vs Growth in Capital Stock |
|---|---|---|
| Agriculture, Forest. & Fish | -0.74 | -0.82 |
| Coal Mining | -0.59 | -0.47 |
| Gold & Uranium Ore Mining | -0.84 | -0.79 |
| Diamond & Other Mining | -0.41 | -0.49 |
| Food | -0.62 | -0.60 |
| Beverages | -0.64 | -0.48 |
| Tobacco | -0.30 | -0.22 |
| Textiles | 0.05 | 0.03 |
| Wearing Apparel | -0.53 | -0.37 |
| Leather & Tanning | -0.44 | -0.42 |
| Footwear | -0.30 | -0.29 |
| Wood | -0.60 | -0.54 |
| Paper | -0.49 | -0.49 |
| Publish & Printing | -0.62 | -0.56 |
| Petroleum Refined | -0.40 | -0.37 |
| Basic Chemicals | -0.50 | -0.54 |
| Other Chem & Fibre | -0.43 | -0.28 |
| Rubber | -0.64 | -0.62 |
| Plastics | -0.56 | -0.47 |
| Glass | -0.59 | -0.57 |
| Other N-Metal Minerals | -0.60 | -0.62 |
| Basic Iron & Steel | -0.45 | -0.48 |
| Bas N-Ferrous Metals | -0.52 | -0.40 |
| Fabricated Metals | -0.62 | -0.63 |
| Machinery | -0.56 | -0.48 |
| Electrical Machine | -0.74 | -0.66 |
| Radio, tv & comm equipm | -0.69 | -0.67 |
| Instruments | -0.31 | -0.30 |
| Motor Veh & Acces | -0.57 | -0.52 |
| Transport Equipmen | -0.66 | -0.70 |
| Furniture | -0.67 | -0.57 |
| Other Maf & Recyc | -0.34 | -0.48 |
| Electricity, Gas & Water | -0.79 | -0.77 |
| Construction | -0.88 | -0.84 |
| Wholesale & Retail Trade | -0.82 | -0.83 |
| Transport, Storage & Commun. | -0.75 | -0.75 |
| Finance, Insurance, Real Est | -0.77 | -0.69 |
| All Economic Activities | -0.54 | -0.53 |
| Average | -0.57 | -0.53 |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b)*

While for the economy as a whole the correlation is only –0.57 for the Investment Rate, and –0.53 for the growth rate in real capital stock, the majority of economic sectors demonstrate a negative correlation between user cost of capital and growth in capital stock that is stronger than the average.[21] In effect, the economy-wide average is lowered by the presence of a few outlier sectors on the down side.

In particular, Textiles & Knitwear, shows a positive correlation between the cost of capital and investment that would not be predicted by economic theory. All other sectors of the economy show the negative association between the marginal cost and marginal changes in the use of capital that economic theory anticipates. Indeed, in the case of a number of sectors this negative correlation is particularly strong such as Construction (-0.88, -0.84), Wholesale & Retail Trade (-0.82, -0.83), Agriculture, Forestry & Fishing (-0.74, -0.82), Gold & Uranium Ore Mining (-0.84, -0.79), and Electricity, Gas & Water (-0.79, -0.77. Thus over time, and for most sectors, the real user cost of capital seems to carry the potential of constituting at least one of the major determinants of investment expenditure in the South African economy –as would be anticipated by economic theory. We will return to this question in the more detailed econometric analysis below.

[21] The median for the correlation between user cost and investment rate is –0.59, and the correlation between user cost and the growth rate of the real capital stock –0.54.

***4.12) Capital Productivity***

Besides changes in the real cost of capital, a further explanation for changing capital usage over time, rests on changes in capital productivity. Table 4.17 reports rankings in the ratio of real GDP produced in the sector to the real stock of capital as measured by Machinery & Equipment in the sector, as a measure of total capital productivity[22] for selected years.

Table 4.17: Capital Productivity: Real GDP/Real Stock of Machinery & Equipment

| | 1970 | 1980 | 1990 | 1997 | Rank 1970 | Rank 1980 | Rank 1990 | Rank 1997 | Δ Rank |
|---|---|---|---|---|---|---|---|---|---|
| Electricity, Gas & Water | 0.41 | 0.28 | 0.27 | 0.46 | 1 | 2 | 1 | 2 | 1 |
| Other Chem & Fibre | 0.71 | 1.30 | 1.82 | 1.65 | 2 | 6 | 9 | 14 | 12 |
| Petroleum Refined | 0.88 | 0.16 | 0.66 | 0.40 | 3 | 1 | 2 | 1 | -2 |
| Basic Iron & Steel | 0.98 | 0.91 | 0.98 | 0.55 | 4 | 3 | 4 | 3 | -1 |
| Bas N-Ferrous Metals | 1.01 | 3.04 | 3.14 | 1.74 | 5 | 16 | 18 | 16 | 11 |
| Plastics | 1.10 | 2.88 | 2.19 | 1.48 | 6 | 15 | 12 | 13 | 7 |
| Agriculture, Forest. & Fish. | 1.31 | 1.12 | 2.24 | 3.01 | 7 | 4 | 13 | 25 | 18 |
| Basic Chemicals | 1.66 | 2.07 | 2.48 | 1.91 | 8 | 10 | 15 | 19 | 11 |
| Diamond & Other Mining | 1.74 | 1.12 | 0.99 | 0.81 | 9 | 5 | 5 | 4 | -5 |
| Food | 1.92 | 3.67 | 2.87 | 1.30 | 10 | 18 | 17 | 10 | 0 |
| Paper | 2.00 | 4.15 | 1.51 | 1.18 | 11 | 22 | 6 | 7 | -4 |
| Beverages | 2.08 | 3.68 | 2.70 | 1.05 | 12 | 19 | 16 | 6 | -6 |
| Rubber | 2.18 | 3.62 | 3.31 | 1.41 | 13 | 17 | 20 | 11 | -2 |
| Finance, Insurance, Real Est | 2.18 | 2.47 | 2.31 | 2.02 | 14 | 13 | 14 | 21 | 7 |
| Transport, Storage & Commun. | 2.37 | 2.01 | 1.53 | 1.77 | 15 | 9 | 7 | 17 | 2 |
| Textiles | 2.40 | 4.43 | 2.17 | 2.47 | 16 | 23 | 11 | 23 | 7 |
| Other N-Metal Minerals | 2.43 | 3.78 | 3.23 | 1.66 | 17 | 20 | 19 | 15 | -2 |
| Other Maf & Recyc | 2.60 | 4.06 | 9.00 | 24.06 | 18 | 21 | 35 | 37 | 19 |
| Electrical Machine | 2.60 | 5.06 | 4.08 | 4.41 | 19 | 24 | 23 | 30 | 11 |
| Motor Veh & Acces | 2.87 | 6.61 | 3.50 | 2.20 | 20 | 29 | 21 | 22 | 2 |
| Instruments | 3.14 | 2.27 | 4.56 | 6.91 | 21 | 11 | 24 | 35 | 14 |
| Coal Mining | 3.29 | 1.80 | 1.74 | 1.46 | 22 | 8 | 8 | 12 | -10 |
| Wood | 3.51 | 8.52 | 5.22 | 4.28 | 23 | 34 | 25 | 27 | 4 |
| Radio, tv & comm equipm | 3.60 | 2.48 | 7.17 | 2.52 | 24 | 14 | 29 | 24 | 0 |
| Publish & Printing | 4.22 | 5.97 | 5.33 | 1.79 | 25 | 26 | 26 | 18 | -7 |
| Glass | 4.56 | 6.04 | 3.50 | 1.01 | 26 | 27 | 22 | 5 | -21 |
| Wearing Apparel | 5.20 | 7.14 | 8.12 | 8.17 | 27 | 32 | 32 | 36 | 9 |
| Fabricated Metals | 5.68 | 6.76 | 6.87 | 4.69 | 28 | 31 | 28 | 31 | 3 |
| Construction | 6.03 | 1.73 | 2.12 | 2.00 | 29 | 7 | 10 | 20 | -9 |
| Furniture | 6.31 | 12.61 | 7.46 | 4.41 | 30 | 36 | 31 | 29 | -1 |
| Wholesale & Retail Trade | 6.37 | 5.15 | 6.04 | 4.31 | 31 | 25 | 27 | 28 | -3 |
| Transport Equipmen | 7.78 | 6.67 | 10.90 | 1.20 | 32 | 30 | 37 | 8 | -24 |
| Tobacco | 7.80 | 6.44 | 7.43 | 5.19 | 33 | 28 | 30 | 32 | -1 |
| Gold & Uranium Ore Mining | 8.10 | 2.36 | 0.98 | 1.27 | 34 | 12 | 3 | 9 | -25 |
| Machinery | 8.66 | 13.07 | 9.72 | 6.87 | 35 | 37 | 36 | 34 | -1 |
| Leather & Tanning | 9.44 | 7.33 | 8.17 | 3.90 | 36 | 33 | 34 | 26 | -10 |
| Footwear | 9.58 | 9.38 | 8.15 | 5.39 | 37 | 35 | 33 | 33 | -4 |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: high rank indicates high capital productivity, community services is not shown*

*Relative Capital Productivity*

As can be seen in Table 4.17, relative capital productivity showed relatively strong changes over the 1970-97 period. Between 1970 and 1997, twelve of the 37 sectors for which data was available report a change of rank of 10 sectors or greater, and 18 sectors report a change in rank of 7 sectors or greater. Moreover, the correlation between the rank of sectors in 1970, and their rank in 1997, was only +0.56, suggesting a relatively high degree of volatility in relative capital productivity between sectors.

Sectors with strong increases in relative capital productivity include: Other Chemicals & Man-Made Fibres (+12), Basic Non-Ferrous Metals (+11), Plastics (+7), Agriculture, Forestry & Fishing (+18), Basic Chemicals

[22] We need to note here that the measure of capital productivity in the South African economy is materially affected by the measure of output that is employed. Two measures of real output are available: Real Sales (or gross output) and Real GDP (or net output). The appropriate measure is that for Real GDP, since Real Sales incorporates the value of intermediate inputs into production, and does not therefore represent a true measure of true value-added of capital.

(+11), Finance, Insurance & Real Estate (+7), Textiles (+7), Other Manufacturing (+19), Electrical machinery (+11), Instruments (+14), and Wearing Apparel (+9).

Of those sectors with strong growth in relative capital productivity, Other Chemicals & Man-Made Fibres, Agriculture, Forestry & Fishing, Basic Chemicals, and Electrical Machinery also showed strong growth in capital stock (as measured in terms of the growth in the real capital stock, as well as the investment rate) during the 1970's. It is noticeable that the improvement in capital productivity for these sectors took place *after* the capital stock for the sector had shown strong growth, viz. particularly during the 1980's with the improved capital productivity being maintained during the course of the 1990's. One possible interpretation would be that the investment in new capital stock was such as to introduce new technology, thereby improving the productivity of production.

Moreover, it was shown in Table 4.9 that Other Chemicals & Man-Made Fibres experienced strong relative increases in labour productivity over the 1970-97 period. This suggests that technological change for this sectors may have had elements of factor neutrality – enhancing the productivity of both factors of production.

In Tables 4.6 and 4.11 it was shown that for Basic Non-Ferrous Metals and Plastics, growth in capital stock (again as measured either in terms of the growth in the real capital stock, or the investment rate) is concentrated in the 1990's, while for Basic Chemicals there was a revival of the strong investment performance of the 1970's after a lull during the course of the 1980's. For these sectors improvement in capital productivity predates the acceleration in investment activity. Improving capital productivity in perfect capital markets would translate into improvements in the rate of return to capital (a topic to which we turn below). For these sectors capital productivity may thus be the explanation for changing investment activity, whereas for the preceding group investment and associated technological advances may well have led the improvements in capital productivity.

We can also note that for a number of sectors with strong relative improvements in capital productivity no strong temporal patterns are detectable in investment behaviour. Thus, for Finance, Insurance & Real Estate investment was consistently relatively strong, and no strong distinction exists between investment in the 1970's, 1980's and 1990's. Similarly, it can be seen by comparing Tables 4.11 and 4.17 that Textiles, Other Manufacturing, Instruments, and Wearing Apparel all manifest relatively stable investment rates, without great variation between decades. Reasons for the relative change in capital productivity thus cannot be reduced to investment patterns that are accessible at the level of aggregation presented in our data.

On the other hand, a number of sectors experienced strong declines in relative capital productivity. Coal Mining (-10), Publishing & Printing (-7), Glass (-21), Construction (-9), Transport Equipment (-24), Gold & Uranium Mining (-25) and Leather & Tanning (-10) all showed strong decreases in relative capital productivity. While for Coal Mining, Construction and Gold & Uranium Ore Mining the decline in capital productivity has been a long term trend, consistently present since the 1970's, this is not true of the other sectors. For all of the manufacturing sectors, Publishing & Printing, Glass, Transport Equipment and Leather & Tanning the decrease in capital productivity occurs during the course of the 1990's (See Table 4.18). Moreover, for all of these sectors

the decline in capital productivity in the 1990's is not only marked, but occurs off relatively high levels in absolute terms.

Table 4.18: Average Growth Rates in Capital Productivity:

| | 1970s | 1980s | 1990s | 1970-97 | Rank 1970s | Rank 1980s | Rank 1990s | Rank 1970-97 |
|---|---|---|---|---|---|---|---|---|
| Gold & Uranium Ore Mining | -9.96 | -11.62 | 5.21 | -6.08 | 3 | 1 | 33 | 1 |
| Transport Equipmen | -1.57 | 7.59 | -20.66 | -3.83 | 12 | 31 | 1 | 2 |
| Construction | -12.94 | 2.27 | -0.36 | -3.58 | 1 | 21 | 28 | 3 |
| Glass | 3.56 | -2.82 | -10.92 | -3.09 | 20 | 4 | 4 | 4 |
| Leather & Tanning | -2.88 | 4.10 | -9.35 | -2.21 | 8 | 30 | 6 | 5 |
| Diamond & Other Mining | -4.68 | 1.93 | -4.33 | -2.13 | 5 | 20 | 19 | 6 |
| Footwear | -0.22 | 0.27 | -5.30 | -1.54 | 15 | 11 | 16 | 7 |
| Publish & Printing | 4.01 | 1.36 | -11.28 | -1.50 | 23 | 16 | 3 | 8 |
| Coal Mining | -2.59 | 0.44 | -2.14 | -1.34 | 9 | 12 | 24 | 9 |
| Wholesale & Retail Trade | -3.30 | 2.54 | -3.88 | -1.31 | 7 | 23 | 20 | 10 |
| Basic Iron & Steel | -0.40 | 3.44 | -8.18 | -1.29 | 14 | 27 | 7 | 11 |
| Beverages | 5.24 | 1.89 | -12.42 | -1.23 | 26 | 19 | 2 | 12 |
| Transport, Storage & Commun. | -2.20 | -2.30 | 2.28 | -0.91 | 11 | 7 | 29 | 13 |
| Food | 7.05 | -2.38 | -8.01 | -0.90 | 28 | 6 | 8 | 14 |
| Rubber | 3.88 | 3.96 | -10.37 | -0.31 | 22 | 28 | 5 | 15 |
| Fabricated Metals | 0.92 | 2.53 | -4.93 | -0.22 | 16 | 22 | 17 | 16 |
| Finance, Insurance, Real Est | 1.10 | 0.64 | -2.47 | -0.13 | 18 | 13 | 23 | 17 |
| Other N-Metal Minerals | 3.75 | 1.63 | -6.37 | -0.03 | 21 | 17 | 12 | 18 |
| Furniture | 4.34 | 0.96 | -5.67 | 0.12 | 25 | 14 | 15 | 19 |
| Paper | 8.62 | -4.26 | -3.79 | 0.17 | 33 | 3 | 21 | 20 |
| Machinery | 4.27 | -5.31 | 2.77 | 0.28 | 24 | 2 | 31 | 21 |
| Radio, tv & comm equipm | -7.54 | 14.19 | -7.99 | 0.37 | 4 | 36 | 9 | 22 |
| Tobacco | 0.97 | 4.09 | -4.33 | 0.56 | 17 | 29 | 18 | 23 |
| Electricity, Gas & Water | -3.36 | -1.23 | 7.56 | 0.66 | 6 | 9 | 36 | 24 |
| Petroleum Refined | -11.19 | 17.14 | -6.20 | 0.78 | 2 | 37 | 13 | 25 |
| Motor Veh & Acces | 8.14 | 1.65 | -7.85 | 1.00 | 32 | 18 | 10 | 26 |
| Textiles | 7.66 | -2.40 | -1.69 | 1.16 | 30 | 5 | 26 | 27 |
| Wood | 10.01 | -0.36 | -3.40 | 2.20 | 36 | 10 | 22 | 28 |
| Basic Chemicals | 5.59 | 2.81 | -1.98 | 2.32 | 27 | 24 | 25 | 29 |
| Plastics | 9.39 | 3.38 | -6.46 | 2.47 | 35 | 26 | 11 | 30 |
| Wearing Apparel | 3.39 | 1.02 | 3.56 | 2.56 | 19 | 15 | 32 | 31 |
| Electrical Machine | 7.72 | -1.67 | 2.54 | 2.71 | 31 | 8 | 30 | 32 |
| Other Chem & Fibre | 9.09 | 3.00 | -1.45 | 3.71 | 34 | 25 | 27 | 33 |
| Agriculture, Forest. & Fish. | -0.94 | 8.30 | 5.31 | 4.34 | 13 | 33 | 34 | 34 |
| Instruments | -2.37 | 9.33 | 6.55 | 4.60 | 10 | 34 | 35 | 35 |
| Bas N-Ferrous Metals | 13.17 | 7.75 | -5.88 | 5.52 | 37 | 32 | 14 | 36 |
| Other Maf & Recyc | 7.34 | 13.83 | 16.11 | 12.34 | 29 | 35 | 37 | 37 |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: high rank indicates high growth rate*

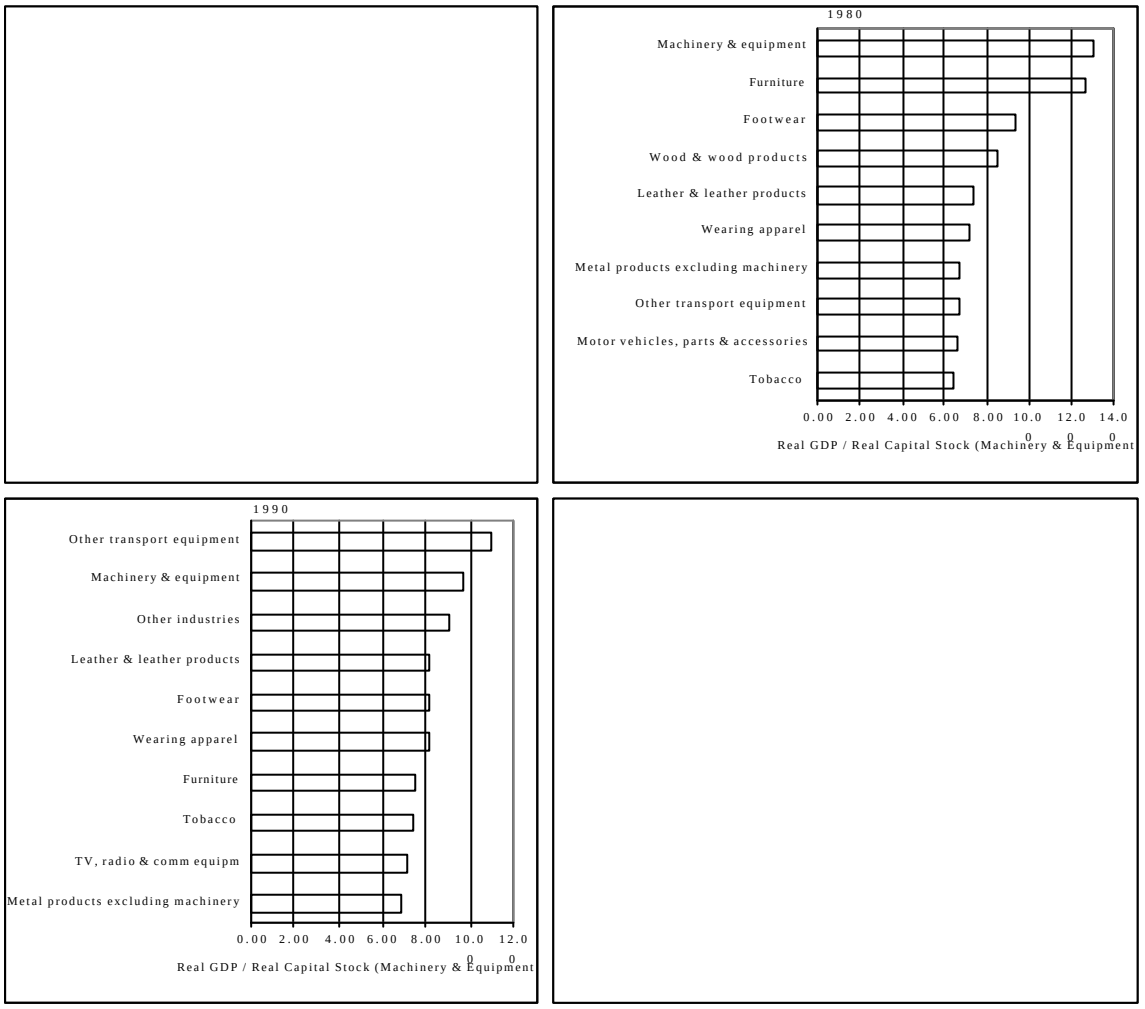
What is noticeable is that for all of the manufacturing sectors with strong declines in relative capital productivity during the 1990's, the growth rate of the real capital stock (as measured by Machinery & Equipment) was amongst the highest in the economy. Thus, Publishing & Printing (14.15%), Glass (20.38%), Transport Equipment (26.19%) and Leather & Tanning (10.44%) all demonstrate very healthy average proportional increases in real capital stock.

One interpretation of the evidence on the manufacturing sectors suggests that since all sectors began from relatively high levels of capital productivity at the end of the 1980's, the impetus to investment in these sectors came from high capital productivity, and presumed associated high rates of return on capital. If so, the strong declines in the productivity of capital associated with the strong increases in capital stock are not surprising, given standard expectations concerning marginal productivity of factors of production. But the decline in the productivity of capital also suggests that the impetus to strong investment performance in these sectors is also on the wane, raising the possibility that significant contributions to the aggregate investment rate of the economy from these sectors may decline over time.

*Absolute Capital Productivity*

Relative capital productivity gives little indication of absolute levels of capital productivity by sector. Figure 4.4 therefore reports the ratio of real GDP to the real Stock of Machinery & Equipment for the top ranked economic sector and selected years.

Figure 4.4: Sectoral capital productivity for selected years (Real GDP / Real Capital stock)




*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b)*

The divergence in the economy at first sight appears to have been widening over time. The ratio of the highest to lowest capital-output ratio (not shown here) moves from 23.37 in 1970, to 81.69 in 1980, 40.37 in 1990, and 60.15 in 1997. However, the 1997 figure is misleading, since it depends on a strong increase in capital productivity in Other Manufacturing & Recycling, which achieved the increase in capital productivity while maintaining a negative growth rate in real capital stock (-4.95%) on average during the course of the 1980's. The increase in capital productivity is thus based on a shedding of capital stock, and productivity gains in the sector may well prove unsustainable over time. By contrast, the ratio of the capital productivity of the second-ranked sector to the lowest ranked sector in the economy is 20.43. Hence, where the Other Manufacturing & Recycling outlier is removed from the sample, the ratio of most to least capital productivity in the economy has been on a steady downward trend.

One interpretation of this evidence is that it is consistent with the argument of earlier subsections, of a decrease in market distortions in the South African capital markets. While the 1970's and 1980's showed strong distortions in the distribution of capital across sectors in the economy, such that the productivity of capital was strongly differentiated across sectors, subsequent reallocation of capital stock in the economy appears to have equalised the productivity of capital across sectors. From a theoretical point we would anticipate that perfect capital markets would serve to equalise the marginal product of capital across sectors, thereby generating the most efficient allocation of capital stock. This suggests that the reallocation of capital has been such as to achieve at least an improved use of scarce capital resources in the economy. Whatever the source of the reallocation, therefore, capital market developments during the course of the 1990's continue to show features of a desirable restructuring in the allocation of capital stock. In this sense, the evidence of the present section continues to confirm the evidence of earlier subsections that the severity of past capital market distortions have been on a downward trend since 1990.

***4.13) Links between capital productivity, real cost of capital and capital usage***

Economic theory would anticipate a link between real capital productivity and the real user cost of capital. Table 4.19 presents correlation coefficients between real capital productivity and the real user cost of capital by economic sector.

It is noticeable that for most sectors the correlation between capital productivity and the real user cost of capital is not only positive, but frequently very strong. For one sector[23] the correlation lies above +0.9, for six[24] sectors above +0.8, for seven[25] above +0.7, and for fourteen [26] is equal to or above +0.50. Thus, for 28 out of 37 sectors, the correlation coefficients conforms not only to economic theory, but are reasonably strong – if it is borne in mind that economic theory assumes all other influences on the real user cost of capital to be held constant in predicting a positive correlation between the productivity and the cost of factors of production.

For only five[27] sectors does the correlation coefficients lie between 0 and +0.5, and is the link predicted by economic theory thus relatively weak – and five[28] more sectors had the negative correlation between capital productivity and the real user costs of capital contradicting economic theory.

Noteworthy is the distinct performance of these groupings of economic sectors in terms of investment rates. The grouping of sectors with the strongest correlation between the real user cost of capital and capital productivity, viz. in excess of +0.8, also shows the highest average growth rate in real capital stock over the 1970-97 period. For average investment rates computed over the full 1970-97 time frame, it is not as clear that the group of sectors with a strong positive correlation between real user cost of capital and capital productivity also has the

[23] Basic Non-Ferrous Metals.
[24] In declining order: Publishing & Printing, Transport equipment, Beverages, Food, Other Chemicals & Man-made Fibres, Leather & Tanning.
[25] In declining order: Rubber, Wood, Footwear, Fabricated Metals, Other Manufacturing & Recycling, Plastics, Instruments.
[26] In declining order: Other Non-Metallic Minerals, Basic Iron & Steel, Basic Chemicals, Furniture, Motor Vehicles & Accessories, Coal Mining, Glass, Textiles & Knit, Agriculture, Forestry & Fishing, Radio, TV & Communications Equipment, Electrical Machinery, Wearing Apparel, Petroleum Refined, Electricity, Gas & Water.
[27] In declining order: Tobacco, Wholesale & Retail Trade, Paper, Finance, Insurance, Real Estate.
[28] In declining order: Diamond & Other Mining, Transport, Storage & Communications, Gold & Uranium Ore Mining, Machinery & Apparatus, Construction.

highest investment rate. Nor does the average 1970-97 growth rate in real capital stock unambiguously decline as we move to sectoral groupings with lower correlations between real user cost of capital and capital productivity.

Table 4.19: Correlations between real user costs of capital and various measures of capital stock growth

| | Correlation real user costs of capital and capital productivity | Average Investment Rate 1970-97 | Average Investment Rate 1990-97 | Average Growth in Real Capital: 1970-97 | Average Growth in Real Capital: 1970-97 |
|---|---|---|---|---|---|
| Bas N-Ferrous Metal | 0.92 | 0.06 | 0.13 | 0.09 | 0.26 |
| Publish & Printing | 0.87 | 0.02 | 0.04 | 0.06 | 0.14 |
| Transport Equipmen | 0.84 | 0.03 | 0.09 | 0.07 | 0.27 |
| Beverages | 0.84 | 0.03 | 0.07 | 0.07 | 0.12 |
| Food | 0.84 | 0.02 | 0.05 | 0.04 | 0.11 |
| Other Chem & Fibre | 0.81 | 0.03 | 0.01 | 0.03 | 0.02 |
| Leather & Tanning | 0.80 | 0.01 | 0.02 | 0.05 | 0.13 |
| Rubber | 0.79 | 0.01 | 0.04 | 0.03 | 0.10 |
| Wood | 0.78 | 0.01 | 0.01 | 0.02 | 0.06 |
| Footwear | 0.75 | 0.00 | 0.00 | 0.02 | 0.03 |
| Fabricated Metals | 0.75 | 0.00 | 0.01 | 0.02 | 0.06 |
| Other Maf & Recyc | 0.74 | 0.00 | 0.00 | -0.01 | -0.04 |
| Plastics | 0.73 | 0.03 | 0.05 | 0.07 | 0.11 |
| Instruments | 0.70 | 0.00 | -0.01 | 0.00 | -0.06 |
| Other N-Metal Minerals | 0.67 | 0.01 | 0.03 | 0.03 | 0.07 |
| Basic Iron & Steel | 0.65 | 0.06 | 0.16 | 0.06 | 0.14 |
| Basic Chemicals | 0.59 | 0.01 | 0.02 | 0.03 | 0.04 |
| Furniture | 0.58 | 0.01 | 0.01 | 0.05 | 0.06 |
| Motor Veh & Acces | 0.58 | 0.01 | 0.02 | 0.04 | 0.08 |
| Coal Mining | 0.56 | 0.03 | 0.01 | 0.08 | 0.02 |
| Glass | 0.54 | 0.03 | 0.08 | 0.10 | 0.21 |
| Textiles | 0.54 | 0.00 | 0.00 | 0.00 | 0.01 |
| Agriculture, Forest. & Fish. | 0.53 | 0.00 | -0.02 | 0.00 | -0.03 |
| Radio, tv & comm equipm | 0.52 | 0.01 | 0.03 | 0.05 | 0.11 |
| Electrical Machine | 0.52 | 0.01 | 0.00 | 0.02 | 0.00 |
| Wearing Apparel | 0.52 | 0.00 | 0.00 | 0.01 | -0.01 |
| Petroleum Refined | 0.52 | 0.20 | 0.08 | 0.06 | 0.04 |
| Electricity, Gas & Water | 0.50 | 0.14 | -0.13 | 0.05 | -0.04 |
| Tobacco | 0.49 | 0.00 | 0.00 | 0.01 | 0.05 |
| Wholesale & Retail Trade | 0.47 | 0.01 | 0.01 | 0.04 | 0.06 |
| Paper | 0.35 | 0.03 | 0.03 | 0.08 | 0.05 |
| Finance, Insurance, Real Est | 0.28 | 0.02 | 0.02 | 0.06 | 0.05 |
| Diamond & Other Mining | -0.04 | 0.05 | 0.06 | 0.06 | 0.06 |
| Transport, Storage & Commun. | -0.05 | 0.02 | 0.00 | 0.04 | 0.00 |
| Gold & Uranium Ore Mining | -0.08 | 0.01 | -0.04 | 0.04 | -0.05 |
| Machinery | -0.50 | 0.00 | 0.00 | 0.01 | -0.01 |
| Construction | -0.56 | 0.01 | -0.01 | 0.04 | -0.01 |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b)*

But it is worth recalling that the analysis of the preceding sections has suggested that the degree of market distortions in South African capital markets appear to have been falling over time, leading to a reallocation of capital stock. If so, the effect of the theoretically appropriate relationship between user cost of capital and capital productivity should have had desirable impacts on the investment rate and the average growth rate in the real capital stock in later time periods rather than earlier ones. This is indeed borne out by the evidence:

- For the seven sectors with the strongest correlations between the real user cost of capital and capital productivity, the average investment rate was 6%, while the average growth rate in real capital stock was 15%, over the 1990-97 period.
- For the seven sectors with correlations between the real user cost of capital and capital productivity between 0.7 and 0.8, the average investment rate was 1%, while the average growth rate in real capital stock was 4%, over the 1990-97 period.
- For the fourteen sectors with correlations between the real user cost of capital and capital productivity between 0.5 and 0.7, the average investment rate was 2%, while the average growth rate in real capital stock was 5%, over the 1990-97 period.

- For the five sectors with correlations between the real user cost of capital and capital productivity between 0 and 0.5, the average investment rate was 2%, while the average growth rate in real capital stock was 5%, over the 1990-97 period.
- For the five sectors with negative correlations between the real user cost of capital and capital productivity, the average investment rate was 0%, while the average growth rate in real capital stock was 0%, over the 1990-97 period.

With the exception of perhaps only the sector grouping with a correlation between +0.7 and +0.8, the evidence appears to suggest the presence of declining investment rates in sectors as they conform less closely to the dictates of standard economic theory. Where the real user cost of capital is less closely linked to real capital productivity, the growth in capital also tends to be lower.

The implications that appear to flow from the above evidence is that for purposes of policy intervention in South African capital markets, "well-functioning" capital markets, defined as those that link factor rewards to factor productivity in accordance with the requisites of economic theory, appear to be more likely to generate higher investment rates.

***4.14) The Rate of Return on Capital***

The final consideration in our discussion of South African capital markets concerns the rate of return on capital stock by economic sector. In terms of economic theory, the rate of return on capital stock should again be one of the main determinants of investment expenditure, representing as it does the "reward" for committing to a capital project. We compute the rate of return on capital as:

$$Rate\ of\ return\ on\ Capital = \frac{Real\ Gross\ Operating\ Surplus}{Real\ Stock\ of\ Machinery\ \&\ Equipment} \tag{4.3}$$

As discussed before, our choice of capital stock variable is dictated by the relevance of other capital stock variables particularly the Building & Construction time series[29]. Both data choices will have the tendency to bias the measure of the rate of return on capital stock that we compute upward. However, since we are concerned with trends in the real rate of return as long as the bias in the measure is consistent over time, the measure should be suitable for our purposes

Table 4.20 reports the relative rate of return on capital across sectors, together with average growth in the rate of return on capital over the 1970-97 period, and the volatility of this growth rate. In addition, Table 4.21 reports average rates of return on capital on a decade basis, with the associated average growth rates per decade, and Table 4.22 presents correlations coefficients between the rate of return on capital and the growth rate in capital.

A number of sectors experienced strong increases in the relative rate of return on their capital stock. Basic Non-Ferrous Metals (+16), Other Manufacturing & Recycling (+31), Motor Vehicles & Accessories (+12), Electrical

[29] Gross Operating Surplus is defined as the sum of Profit, Interest Paid, Interest Received and Other and allowance for depreciation. We currently do not have the individual series to be able to compute the Profit time series.

Machinery (+12), Basic Chemicals (+10) Finance, Insurance & Real Estate (+11), and Agriculture, Forestry & Fishing (+19) all improved their relative ranking considerably. By contrast, Diamond & Other Mining (-15), Beverages (-13), Glass (-21), Transport Equipment (-31), and Gold & Uranium Ore Mining (-31) all showed strong decreases in their relative rate of return on capital as measured by their industry rank.

We note that these strong relative changes are not distributed evenly over time. Basic Non-Ferrous Metals, Motor Vehicles & Accessories, Electrical Machinery, Transport Equipment and Diamond & Other Mining experienced the relative rate of return change during the 1980's. By contrast, Basic Chemicals, Finance, Insurance & Real Estate, Beverages, Glass, and Gold & Uranium Ore Mining had the impact of their relative rate of return change strike them during the course of the 1990's.

Table 4.20: Gross Operating Surplus/Capital stock ratios

| | 1970 rank | 1980 rank | 1990 rank | 1997 rank | change in rank 1970-97 | unweight average annual growth 1970-97 | rank unweight average annual growth 1970-97 | st dev unweight average annual growth 1970-97 | rank st unweight average annual growth 1970-97 |
|---|---|---|---|---|---|---|---|---|---|
| Electricity, Gas & Water | 1 | 2 | 2 | 2 | 1 | 0.47 | 15 | 6.87 | 1 |
| Basic Iron & Steel | 2 | 3 | 4 | 4 | 2 | 0.72 | 17 | 14.25 | 10 |
| Other Chem & Fibre | 3 | 4 | 9 | 10 | 7 | 2.56 | 27 | 11.85 | 6 |
| Plastics | 4 | 13 | 12 | 13 | 9 | 4.05 | 32 | 22.15 | 26 |
| Bas N-Ferrous Metals | 5 | 25 | 20 | 21 | 16 | 7.02 | 37 | 28.09 | 33 |
| Petroleum Refined | 6 | 1 | 3 | 3 | -3 | 1.53 | 21 | 31.88 | 35 |
| Other Maf & Recyc | 7 | 15 | 37 | 38 | 31 | 13.90 | 38 | 31.27 | 34 |
| Transport, Storage & Commun. | 8 | 8 | 16 | 17 | 9 | 0.55 | 16 | 7.38 | 2 |
| Paper | 9 | 27 | 15 | 16 | 7 | 2.32 | 25 | 22.03 | 25 |
| Motor Veh & Acces | 10 | 30 | 21 | 22 | 12 | 6.50 | 36 | 34.53 | 36 |
| Food | 11 | 18 | 10 | 11 | 0 | -0.93 | 7 | 11.30 | 5 |
| Electrical Machine | 12 | 22 | 23 | 24 | 12 | 2.34 | 26 | 17.05 | 15 |
| Basic Chemicals | 13 | 11 | 22 | 23 | 10 | 2.89 | 29 | 20.25 | 24 |
| Rubber | 14 | 19 | 8 | 9 | -5 | -0.48 | 9 | 19.67 | 21 |
| Finance, Insurance, Real Est | 15 | 12 | 25 | 26 | 11 | 1.57 | 22 | 10.51 | 3 |
| Agriculture, Forest. & Fish. | 16 | 10 | 34 | 35 | 19 | 5.33 | 34 | 19.14 | 20 |
| Textiles | 17 | 23 | 18 | 19 | 2 | 0.38 | 13 | 16.83 | 14 |
| Construction | 18 | 6 | 14 | 15 | -3 | -0.74 | 8 | 13.41 | 8 |
| Furniture | 19 | 33 | 26 | 27 | 8 | 6.21 | 35 | 36.75 | 37 |
| Other N-Metal Minerals | 20 | 20 | 19 | 20 | 0 | 0.79 | 18 | 18.66 | 19 |
| Diamond & Other Mining | 21 | 7 | 6 | 6 | -15 | -1.79 | 4 | 17.36 | 16 |
| Radio, tv & comm equipm | 22 | 9 | 24 | 25 | 3 | 1.89 | 23 | 19.71 | 22 |
| Publish & Printing | 23 | 17 | 13 | 14 | -9 | 0.89 | 19 | 25.33 | 32 |
| Wood | 24 | 37 | 28 | 29 | 5 | 3.76 | 31 | 25.03 | 31 |
| Beverages | 25 | 28 | 11 | 12 | -13 | -1.05 | 6 | 18.26 | 17 |
| Wearing Apparel | 26 | 16 | 29 | 30 | 4 | 3.45 | 30 | 23.43 | 28 |
| Coal Mining | 27 | 14 | 17 | 18 | -9 | 0.42 | 14 | 24.48 | 29 |
| Fabricated Metals | 28 | 26 | 27 | 28 | 0 | 1.32 | 20 | 16.51 | 13 |
| Glass | 29 | 35 | 7 | 8 | -21 | -1.18 | 5 | 24.70 | 30 |
| Footwear | 30 | 31 | 33 | 34 | 4 | 2.10 | 24 | 19.85 | 23 |
| Machinery | 31 | 34 | 35 | 36 | 5 | 2.64 | 28 | 18.52 | 18 |
| Transport Equipmen | 32 | 5 | 1 | 1 | -31 | -5.50 | 2 | 67.52 | 38 |
| Wholesale & Retail Trade | 33 | 24 | 30 | 31 | -2 | -0.27 | 11 | 13.84 | 9 |
| Leather & Tanning | 34 | 29 | 31 | 32 | -2 | 0.37 | 12 | 15.46 | 12 |
| Instruments | 35 | 32 | 36 | 37 | 2 | 4.44 | 33 | 15.19 | 11 |
| Gold & Uranium Ore Mining | 36 | 21 | 5 | 5 | -31 | -7.81 | 1 | 12.88 | 7 |
| Tobacco | 37 | 36 | 32 | 33 | -4 | -0.39 | 10 | 23.35 | 27 |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), note: high rank indicates high rate of return*

It is also worth noting that a number of the sectors with strong improvements in their relative real rate of return on capital, experienced strong growth in their real capital stock in periods corresponding to the rate of return improvements. Thus, Basic Chemicals (4.08%), Basic Non-Ferrous Metals (25.87%), Motor Vehicles & Accessories (7.51%), Finance, Insurance & Real Estate (4.90%) all showed strong real growth in capital stock. Gold & Uranium Ore Mining constitutes a symmetrical but opposite case, combining strong declines in the relative rate of return on capital with low growth in real capital stock (-5.39%).

Table 4.21: Gross Operating Surplus/Capital stock ratios

| | average ratio 1970s | average ratio 1980s | average ratio 1990s | growth average ratio 1970s | growth average ratio 1980s | growth average ratio 1990s |
|---|---|---|---|---|---|---|
| Electricity, Gas & Water | 0.29 | 0.18 | 0.25 | -2.25 | -2.28 | 7.89 |
| Basic Iron & Steel | 0.30 | 0.42 | 0.42 | 1.05 | 5.54 | -6.61 |
| Petroleum Refined | 0.46 | 0.35 | 0.42 | -10.49 | 17.47 | -5.81 |
| Plastics | 0.49 | 1.11 | 0.93 | 11.38 | 5.07 | -6.85 |
| Other Chem & Fibre | 0.52 | 0.61 | 0.76 | 7.48 | 3.21 | -4.68 |
| Transport, Storage & Commun. | 0.74 | 0.67 | 0.71 | 1.14 | -1.63 | 2.91 |
| Wearing Apparel | 0.81 | 1.38 | 2.07 | 1.77 | 5.48 | 2.71 |
| Radio, tv & comm equipm | 0.83 | 1.22 | 2.33 | -7.30 | 15.53 | -5.80 |
| Publish & Printing | 0.85 | 1.27 | 1.30 | 4.41 | 4.38 | -8.62 |
| Rubber | 0.87 | 1.60 | 0.94 | 4.76 | 3.76 | -13.26 |
| Diamond & Other Mining | 0.91 | 0.67 | 0.46 | -3.60 | 1.83 | -4.64 |
| Bas N-Ferrous Metals | 0.92 | 1.98 | 1.33 | 16.84 | 9.50 | -9.14 |
| Transport Equipmen | 0.94 | 1.27 | 0.67 | 1.06 | 10.12 | -36.25 |
| Motor Veh & Acces | 0.95 | 1.35 | 1.23 | 9.78 | 13.46 | -7.65 |
| Agriculture, Forest. & Fish. | 0.96 | 1.04 | 2.09 | -0.48 | 9.59 | 6.73 |
| Furniture | 0.98 | 1.52 | 1.68 | 8.85 | 9.16 | -1.40 |
| Basic Chemicals | 0.99 | 0.84 | 1.33 | 5.11 | 3.47 | -0.79 |
| Construction | 0.99 | 0.59 | 0.69 | -6.19 | 3.04 | 0.85 |
| Other N-Metal Minerals | 1.00 | 1.24 | 1.29 | 3.69 | 2.50 | -5.36 |
| Finance, Insurance, Real Est | 1.06 | 1.39 | 1.31 | 3.89 | 1.98 | -1.99 |
| Food | 1.07 | 1.33 | 0.94 | 6.83 | -2.59 | -8.54 |
| Wood | 1.11 | 2.30 | 1.93 | 11.34 | 3.18 | -5.15 |
| Electrical Machine | 1.14 | 1.52 | 1.75 | 7.53 | -0.68 | -0.01 |
| Paper | 1.16 | 1.08 | 1.00 | 11.50 | -1.37 | -4.23 |
| Textiles | 1.22 | 1.42 | 1.05 | 7.06 | -2.36 | -4.29 |
| Beverages | 1.24 | 1.82 | 0.92 | 4.67 | 3.12 | -14.35 |
| Other Maf & Recyc | 1.30 | 2.30 | 4.60 | 11.32 | 17.20 | 12.52 |
| Fabricated Metals | 1.36 | 1.82 | 1.65 | 0.74 | 4.63 | -2.67 |
| Footwear | 1.48 | 2.47 | 2.47 | 2.55 | 5.05 | -2.72 |
| Glass | 1.71 | 1.80 | 1.73 | 7.49 | -0.40 | -13.45 |
| Coal Mining | 1.76 | 1.08 | 0.69 | 2.40 | -0.62 | -0.65 |
| Leather & Tanning | 1.85 | 3.13 | 2.69 | -1.72 | 9.38 | -9.82 |
| Wholesale & Retail Trade | 1.99 | 1.81 | 1.96 | -5.75 | 5.81 | -1.90 |
| Machinery | 2.41 | 2.09 | 3.21 | 2.25 | -1.51 | 9.05 |
| Instruments | 2.50 | 3.83 | 7.40 | -3.30 | 11.25 | 4.68 |
| Gold & Uranium Ore Mining | 3.48 | 0.94 | 0.53 | -7.57 | -14.88 | 1.99 |
| Tobacco | 4.94 | 4.50 | 2.33 | -0.49 | 5.94 | -9.31 |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b)*

However, for a number of other sectors this intuitively appealing association no longer holds. For Diamond & Other Mining (5.55%), Beverages (12.24%), Glass (20.38%), and Transport Equipment (26.19%) growth in the real capital stock (see Table 4.6) was comfortably positive and strong, while the relative rate of return on capital stock was falling. For some sectors (Glass, Beverages), a partial explanation may lie in the fact that the absolute level of the rate of return of capital remained high, despite the falling relative rates of return (see for evidence, Table 4.21). For Diamond & Other Mining the explanation may lie in the fact that it has consistently experienced the lowest (or second lowest during the course of the 1980's) user cost of capital of any sector in the South African economy (by way of contrast, Beverages and Glass faced amongst the highest real user costs). Similarly, Transport Equipment producers experienced a strong decline in their relative real user cost of capital from the 1980's to the 1990's, which may again provide a partial explanation of its growth in real capital stock despite falling rates of return on capital.

Table 4.22: Correlations of rate of return on capital vs growth rate in real capital stock

| | Correlation coefficient |
|---|---|
| Construction | 0.91 |
| Wholesale & Retail Trade | 0.59 |
| Furniture | 0.58 |
| Diamond & Other Mining | 0.57 |
| Motor Veh & Acces | 0.52 |
| Textiles | 0.47 |
| Gold & Uranium Ore Mining | 0.39 |
| Wood | 0.37 |
| Machinery | 0.34 |
| Other N-Metal Minerals | 0.31 |
| Coal Mining | 0.30 |
| Plastics | 0.27 |
| Publish & Printing | 0.22 |
| Glass | 0.21 |
| Paper | 0.21 |
| Transport, Storage & Commun. | 0.19 |
| Electricity, Gas & Water | 0.18 |
| Fabricated Metals | 0.17 |
| Footwear | 0.16 |
| Basic Chemicals | 0.16 |
| Bas N-Ferrous Metals | 0.16 |
| Wearing Apparel | 0.15 |
| Leather & Tanning | 0.08 |
| Beverages | 0.08 |
| Basic Iron & Steel | 0.07 |
| Tobacco | 0.05 |
| Rubber | 0.04 |
| Radio, tv & comm equipm | 0.00 |
| Other Chem & Fibre | -0.01 |
| Transport Equipmen | -0.05 |
| Electrical Machine | -0.06 |
| Other Maf & Recyc | -0.08 |
| Agriculture, Forest. & Fish. | -0.10 |
| Finance, Insurance, Real Es | -0.19 |
| Food | -0.20 |
| Instruments | -0.32 |
| Petroleum Refined | -0.36 |

*Source: Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b)*

Nevertheless, the evidence of Table 4.22 shows that any adequate explanation of investment in real capital stock will have to look beyond the real rate of return on capital stock, the correlation coefficient between the real rate of return and the growth rate in real capital stock across South African economic sectors ranges from +0.91 to –0.36. On the other hand, since we know investment expenditure to have a multivariate explanation, and ceteris is not paribus in the current context, such variation is perhaps not entirely surprising.

### *4.15) Capacity Utilisation*

Investment can be seen to be determined, at least to some extent, by sales expectations which are themselves fed by the degree to which existing capacity is currently utilised. Higher rates of capacity utilisation spur investment demand (and vice-versa) in order to avoid potential bottlenecks. In this subsection we examine the relationship between capacity utilisation and investment and investment rates.

We consider capacity utilisation rate over the period 1971-1997 for 28 manufacturing sectors (no capacity utilisation rate are available for non-manufacturing sectors). In Table 4.23 it can be seen that Motor Vehicles, Parts & Accessories had the lowest capacity utilisation in 1971, 1980 and 1997. Thus, apart from 1990, this sector has consistently been running at relatively low levels of capacity utilisation. The same can be said of the Other Chemicals & Man-made Fibres and Other Transport Equipment producers, the Machinery and Equipment, Electrical Machinery, TV, Radio and Communication Equipment and Metal Products Industries.

Table 4.23: Capacity utilisation by sector for selected years (%)

| | | rank 1971 | capacity utilisation 1971 | rank 1980 | capacity utilisation 1980 | rank 1990 | capacity utilisation 1990 | rank 1997 | capacity utilisation 1997 | change rank 1970-97 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1. | Motor vehicles, parts & accessories | 1 | 68.6 | 1 | 68.1 | 18 | 85.1 | 1 | 70.4 | 0 |
| 2. | Other chemicals & man-made fibres | 2 | 74.2 | 4 | 76.0 | 4 | 75.8 | 6 | 76.6 | 4 |
| 3. | Other transport equipment | 3 | 74.2 | 2 | 68.9 | 1 | 68.8 | 4 | 73.5 | 1 |
| 4. | Other industries | 4 | 77.8 | 13 | 81.9 | 17 | 84.6 | 7 | 77.8 | 3 |
| 5. | Machinery & equipment | 5 | 80.0 | 5 | 76.5 | 2 | 75.2 | 9 | 78.9 | 4 |
| 6. | Furniture | 6 | 80.0 | 25 | 88.1 | 16 | 82.9 | 15 | 82.3 | 9 |
| 7. | Electrical machinery | 7 | 82.1 | 7 | 77.1 | 5 | 76.2 | 12 | 80.3 | 5 |
| 8. | Television, radio & communication | 8 | 82.1 | 8 | 77.1 | 6 | 76.2 | 13 | 80.4 | 5 |
| 9. | Metal products excluding machinery | 9 | 82.4 | 10 | 79.9 | 10 | 79.9 | 8 | 78.8 | -1 |
| 10. | Tobacco | 10 | 83.0 | 15 | 84.2 | 27 | 92.1 | 2 | 71.0 | -8 |
| 11. | Food | 11 | 83.5 | 16 | 84.5 | 14 | 81.8 | 11 | 79.5 | 0 |
| 12. | Beverages | 12 | 83.8 | 11 | 81.1 | 3 | 75.3 | 3 | 72.4 | -9 |
| 13. | Coke & refined petroleum products | 13 | 84.4 | 21 | 86.5 | 19 | 85.3 | 28 | 92.8 | 15 |
| 14. | Textiles | 14 | 84.6 | 23 | 86.9 | 9 | 79.3 | 14 | 80.8 | 0 |
| 15. | Leather & leather products | 15 | 84.8 | 27 | 88.8 | 24 | 88.8 | 22 | 85.6 | 7 |
| 16. | Non-metallic minerals | 16 | 85.0 | 6 | 76.7 | 11 | 80.2 | 10 | 79.2 | -6 |
| 17. | Plastic products | 17 | 86.0 | 14 | 82.4 | 12 | 80.8 | 5 | 75.4 | -12 |
| 18. | Printing, publishing & recorded media | 18 | 87.9 | 22 | 86.9 | 15 | 82.2 | 17 | 83.6 | -1 |
| 19. | Glass & glass products | 19 | 88.1 | 3 | 75.3 | 25 | 88.9 | 16 | 83.1 | -3 |
| 20. | Professional & scientific equipment | 20 | 88.2 | 18 | 85.3 | 7 | 77.4 | 21 | 85.5 | 1 |
| 21. | Rubber products | 21 | 88.4 | 12 | 81.5 | 13 | 81.3 | 23 | 86.5 | 2 |
| 22. | Wearing apparel | 22 | 88.6 | 19 | 85.7 | 21 | 86.7 | 19 | 84.9 | -3 |
| 23. | Wood & wood products | 23 | 89.1 | 17 | 85.1 | 23 | 86.9 | 25 | 88.4 | 2 |
| 24. | Basic chemicals | 24 | 89.6 | 24 | 87.0 | 8 | 78.1 | 18 | 84.7 | -6 |
| 25. | Basic non-ferrous metals | 25 | 90.1 | 9 | 78.9 | 28 | 93.2 | 27 | 90.3 | 2 |
| 26. | Basic iron & steel | 26 | 90.2 | 26 | 88.7 | 20 | 85.8 | 26 | 89.5 | 0 |
| 27. | Paper & paper products | 27 | 90.3 | 28 | 91.1 | 26 | 89.8 | 20 | 85.3 | -7 |
| 28. | Footwear | 28 | 92.4 | 20 | 86.5 | 22 | 86.7 | 24 | 86.7 | -4 |

*Source: Stats SA*

At the other end of the scale a similar degree of consistency appears. Footwear, Paper , Basic Metals and Basic Chemicals are all sectors that run at relatively high levels of capacity utilisation. Except for a few outliers, it seems that South Africa's basic industries, at the lower end of the "value chain" are running at relatively high levels of capacity utilisation, while further downstream, the opposite conclusion can be drawn. Other sectors that appear to be running out of steam at the end of the period are Beverages (row 12), Tobacco, Plastic Products and Non-Metallic Mineral Product Producers. In the last column we can observe the change in rank between the beginning and the end of the period. On the whole, it would appear that the ranking is more stable at the end of the scales, which reinforces the conclusion reached earlier that upstream industries have a higher capacity utilisation than downstream industries.

In the next table we offer a slightly different angle to the issue of sectoral capacity utilisation by comparing averages for selected periods. Comparing the sectoral averages of the 1980s with the sectoral averages of the 1970s about half of the sectors increased their capacity utilisation, while in the 1990s 75% of the sectors saw a decline compared to the 1980s. For manufacturing as a whole, it can be seen in the last row that capacity utilisation declined from the 1970s to the 1980s and continued to decline during the 1990s.

Table 4.24: Capacity utilisation (average % and standard deviations for selected periods)

| | | ave 1970s 1 | ave 1980s 2 | ave 1990s 3 | stdev 1970s 4 | stdev 1980s 5 | stdev 1990s 6 |
|---|---|---|---|---|---|---|---|
| 29. | Motor vehicles, parts & accessories | 66.8 | 73.7 | 75.3 | 4.2 | 8.1 | 5.6 |
| 30. | Other transport equipment | 71.2 | 69.1 | 70.6 | 2.5 | 3.4 | 2.7 |
| 31. | Other chemicals & man-made fibres | 75.8 | 76.3 | 77.0 | 1.8 | 1.7 | 2.4 |
| 32. | Other industries | 77.1 | 81.7 | 79.5 | 3.0 | 2.4 | 2.3 |
| 33. | Machinery & equipment | 78.4 | 77.3 | 73.5 | 1.7 | 2.4 | 3.7 |
| 34. | Non-metallic minerals | 81.2 | 78.1 | 77.9 | 4.4 | 5.5 | 2.9 |
| 35. | Electrical machinery | 81.5 | 77.8 | 76.3 | 4.4 | 3.3 | 4.0 |
| 36. | Television, radio & communication | 81.5 | 77.8 | 76.3 | 4.4 | 3.3 | 4.0 |
| 37. | Metal products excluding machinery | 81.6 | 79.7 | 77.5 | 3.5 | 3.7 | 2.0 |
| 38. | Glass & glass products | 82.0 | 86.6 | 85.4 | 6.1 | 5.5 | 2.9 |
| 39. | Beverages | 82.6 | 79.7 | 73.4 | 2.2 | 4.7 | 2.6 |
| 40. | Furniture | 83.2 | 87.2 | 82.9 | 3.0 | 2.2 | 2.0 |
| 41. | Basic non-ferrous metals | 83.5 | 85.9 | 89.0 | 5.2 | 4.0 | 2.6 |
| 42. | Wood & wood products | 83.7 | 87.0 | 86.8 | 5.3 | 3.2 | 1.7 |
| 43. | Textiles | 83.7 | 85.9 | 78.3 | 2.7 | 2.5 | 3.7 |
| 44. | Plastic products | 83.7 | 82.3 | 78.2 | 2.7 | 2.7 | 2.1 |
| 45. | Food | 84.9 | 83.5 | 80.1 | 0.7 | 1.4 | 1.7 |
| 46. | Coke & refined petroleum products | 86.2 | 86.8 | 89.4 | 2.0 | 1.9 | 3.0 |
| 47. | Rubber products | 86.5 | 82.3 | 82.4 | 2.9 | 2.8 | 2.3 |
| 48. | Wearing apparel | 86.6 | 87.2 | 87.1 | 2.2 | 2.2 | 2.5 |
| 49. | Printing, publishing & recorded media | 87.0 | 86.5 | 84.2 | 1.9 | 2.7 | 1.4 |
| 50. | Professional & scientific equipment | 87.4 | 84.5 | 81.4 | 4.0 | 3.1 | 4.2 |
| 51. | Leather & leather products | 88.2 | 88.2 | 88.0 | 1.6 | 2.2 | 2.0 |
| 52. | Tobacco | 88.8 | 85.9 | 86.2 | 4.6 | 2.9 | 7.4 |
| 53. | Basic iron & steel | 88.9 | 86.9 | 85.5 | 2.0 | 3.0 | 5.7 |
| 54. | Basic chemicals | 89.1 | 85.3 | 83.0 | 1.8 | 3.6 | 2.4 |
| 55. | Footwear | 89.4 | 91.0 | 85.1 | 2.3 | 2.0 | 3.7 |
| 56. | Paper & paper products | 90.0 | 91.8 | 87.2 | 1.0 | 1.2 | 1.4 |
| 57. | Average manufacturing | 82.2 | 81.5 | 80.3 | 2.2 | 2.2 | 2.2 |

*Source: Stats SA*

The last three columns show the standard deviation of the sectoral capacity utilisations. It appears that, on the whole, the average capacity utilisation of the three decades under review has remained fairly constant, although considerable variation is recorded at the sectoral level. Again there is an indication that on either end of the scale, i.e., the sectors with relatively low and relatively high capacity utilisation have relatively high standard deviations.

With the capacity utilisation discussed we can now turn our attention to its relationship with various aspects of investment. In the next table we show the correlation coefficients between capacity utilisation and investment rates and gross domestic fixed investment. In keeping with the other analysis of the investment project, we report on correlation coefficients between the explanatory variable and several investment indicators. In the first two columns we show the relationship between capacity utilisation and gross domestic fixed investment in machinery and equipment and in the last two columns we tackle the relationship between capacity utilisation and the ratio of investment in machinery and equipment to value added.

Table 4.25: Correlation coefficients between capacity utilisation and investment (1971-1997)

| | 1 | correl coeff capacity utilisation & GDFI (mach & equip) 2 | 3 | correl coeff capacity utilisation & investm rate (mach & 4 |
|---|---|---|---|---|
| 1. | Wearing apparel | 0.72 | Television, radio & communication | 0.75 |
| 2. | Other transport equipment | 0.61 | Electrical machinery | 0.70 |
| 3. | Electrical machinery | 0.57 | Professional & scientific equipment | 0.55 |
| 4. | Wood & wood products | 0.52 | Other transport equipment | 0.46 |
| 5. | Television, radio & communication | 0.52 | Wearing apparel | 0.43 |
| 6. | Motor vehicles, parts & accessories | 0.49 | Wood & wood products | 0.40 |
| 7. | Textiles | 0.42 | Machinery & equipment | 0.37 |
| 8. | Machinery & equipment | 0.39 | Rubber products | 0.30 |
| 9. | Other industries | 0.34 | Basic iron & steel | 0.23 |
| 10. | Coke & refined petroleum products | 0.30 | Motor vehicles, parts & accessories | 0.20 |
| 11. | Metal products excluding machinery | 0.27 | Non-metallic minerals | 0.19 |
| 12. | Basic non-ferrous metals | 0.26 | Basic non-ferrous metals | 0.19 |
| 13. | Basic iron & steel | 0.26 | Printing, publishing & recorded media | 0.18 |
| 14. | Furniture | 0.24 | Leather & leather products | 0.17 |
| 15. | Tobacco | 0.24 | Furniture | 0.16 |
| 16. | Non-metallic minerals | 0.24 | Plastic products | 0.15 |
| 17. | Rubber products | 0.19 | Tobacco | 0.14 |
| 18. | Leather & leather products | 0.09 | Other industries | 0.12 |
| 19. | Footwear | 0.09 | Basic chemicals | 0.11 |
| 20. | Glass & glass products | 0.03 | Paper & paper products | 0.05 |
| 21. | Printing, publishing & recorded media | 0.02 | Metal products excluding machinery | 0.05 |
| 22. | Other chemicals & man-made fibres | 0.01 | Footwear | 0.05 |
| 23. | Paper & paper products | -0.02 | Coke & refined petroleum products | 0.04 |
| 24. | Professional & scientific equipment | -0.05 | Textiles | 0.00 |
| 25. | Basic chemicals | -0.08 | Glass & glass products | -0.01 |
| 26. | Plastic products | -0.52 | Other chemicals & man-made fibres | -0.18 |
| 27. | Food | -0.63 | Food | -0.46 |
| 28. | Beverages | -0.74 | Beverages | -0.56 |

*Source: own calculations*

Although most of the signs are in the expected direction it is clear from both sets of correlation coefficients that further explanatory variables will be required in addition to capacity utilisation in order to offer a satisfactory explanation of investment in South Africa. Note that typical producers of consumer goods such as Food and Beverages and Plastic Products and to some degree Leather and Footwear display negative or very low positive correlation coefficients. Shortening the period of review to the last 10 years (not shown here) suggests that the relationship between capacity utilisation and investment has become more extreme in recent times in that higher positive correlation coefficient but also stronger and more negative relationships are recorded.

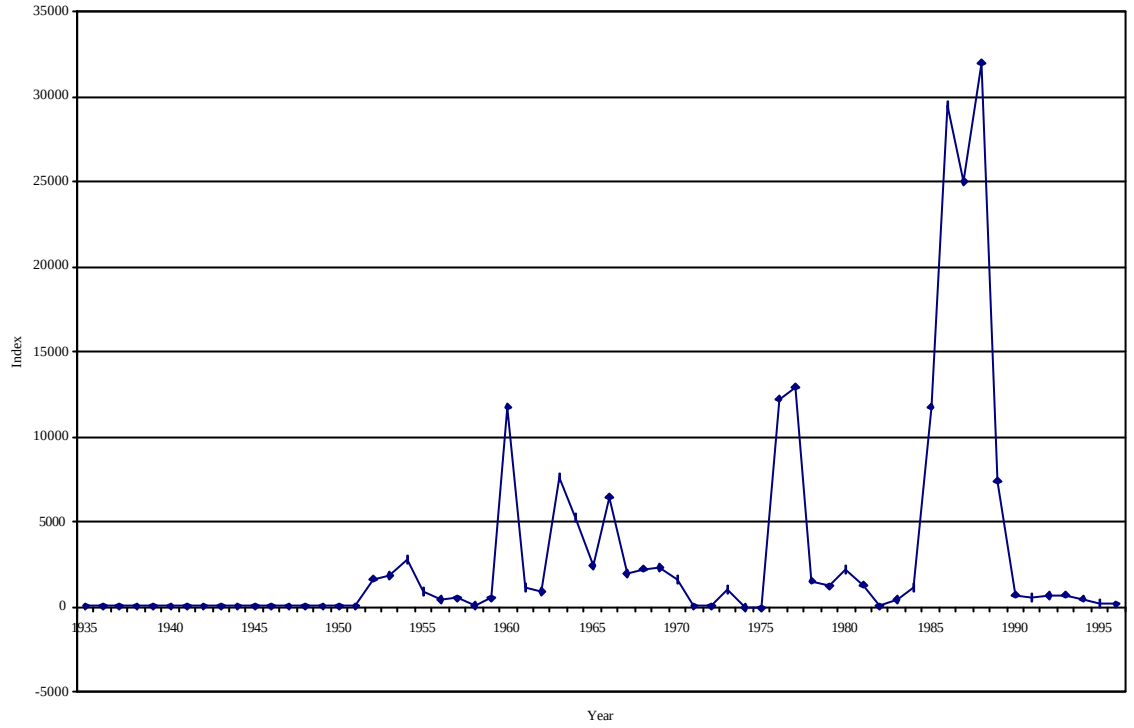
### *4.16) A Political Instability Index*

In section 3 we discussed the sources and components of the political instability index. Given the uncertainty surrounding the appropriate weighting of the components of the repression series, a number of different weightings were presented to a panel of South African experts drawn from a range of disciplines. We present the final "approved" series in Figure 4.5[30].

As can be seen, the index behaves as might be expected, with peaks in the early 1960's, around 1976, and with a particularly strong peak during the course of the 1980's driven primarily by the very considerable number of detentions without trial that emerges at this time. While the ERSA instability index is available over the 1935 – 97 period, for the purposes of the present study it is of course only the 1970-97 period that proves relevant.

[30] For full details of the index see Fedderke, De Kadt, & Luiz (1999a).

Figure 4.5: Political instability




*Source: Fedderke, De Kadt, & Luiz (1999a)*

***4.17) Conclusions***

It is clear from the above that more than just a descriptive analysis is required in order to get a clear picture of the determinants of investment in South Africa. The descriptive analysis has not presented conclusive evidence on the determinants of investment expenditure, although this is not the object of exploratory data analysis. Descriptive analysis is a necessary step towards more detailed analysis in order to check for consistencies in the data series and possible outliers. Nevertheless, the results of the descriptive analysis has shown us some interesting and suggestive findings, some of which were expected and some not. These can now be summarised as follows:

1. A narrow focus on total capital stock is potentially misleading, since on occasion strong changes in one of Building & Construction (see for instance Petroleum refining) or Transport Equipment may distort one's understanding of the fixed capital stock investment performance of sectors in the South African economy. The descriptive analysis above and the econometric analysis that follows are therefore undertaken in terms of the asset type Machinery & Equipment in order to focus specifically on the fixed capital stock of the economy.
2. Sectoral growth rates in capital stock of Machinery & equipment suggest an initial distortion in the South African capital markets due to the heavy reliance on the mining of primary commodities during earlier phases of development of the economy, and the presence of substantial government-led investment in capital stock of a number of core sectors (Electricity, Gas & Water, Petroleum Refining). The gradual reversal of these earlier trends during the course of the 1990's appears to have triggered a restructuring of the South African capital market. In particular, sectors whose access to capital might have previously been

limited due to the demand originating from mining and state sectors (both increasing the financial cost of entry into financial capital markets), have shown strong growth in their capital stock during the earlier decades of our period of review.

3. The implication of such a line of reasoning (if correct), is that one reason why investment expenditure in South Africa is currently at such low levels is simply that strong growth rates in capital stock are being maintained in sectors with low absolute levels of capital stock. Such sectors may have been prevented from increasing their capital stock due to past biases in the economy's capital markets.
4. Evidence from the absolute level of capital usage as measured by Machinery & Equipment has offered some support to the possibility that the 1990's and its changed policy environment may have had an impact on capital usage in the South African economy. This is most evident in the declining Machinery & Equipment capital stock in Electricity, Gas & Water, and above all the strong increase in the usage of this category of capital by the Basic Iron & Steel and Diamond and Other Mining sectors. Given that the period after 1985 saw a sharp decrease in the value of the Rand without any recovery post-1990, the implication is that the increased exposure to capital in these sectors took place despite the increasing supply price of capital goods – and one plausible explanation for such changes may be the changes in the trade dispensation that occurred during the 1990's.
5. Some of the sectors with the highest growth in capital stock over the period 1970-1997 have experienced negative growth rates in real per labour remuneration and above average growth in labour productivity. The implication is that the real cost of labour is unlikely to have been the driving force for increased investment in capital for these sectors.
6. For the economy as a whole the *investment rate* (defined as GDFI divided by value added) of Machinery & Equipment throughout the 1970-97 period has been rather poor, remaining at 2% throughout the 1970's and 1980's, and declining yet further to 1% during the course of the 1990's. However, what is noticeable is the emergence during the course of the 1990's of the manufacturing sector as leader in investment rates in a number of its subsectors. As for the growth in real capital stock therefore, the encouraging implication of such a line of interpretation (if correct), is that one reason why investment expenditure in South Africa is currently at such low levels is simply that strong growth rates in capital stock are being maintained in sectors with low absolute levels of capital stock. As mentioned earlier, such sectors may have been prevented from increasing their capital stock due to past distortions in the economy's capital markets.
7. The possibility of a structural break in capital accumulation during the 1990's does not appear to be translating into a greater volatility of investment. For the economy as a whole the standard deviation of the growth rate of the real stock of Machinery & Equipment declines during the 1980's and the 1990's. Therefore, the structural break in investment behaviour, if present, has not manifested itself in greater volatility of investment – but rather in a different distribution of investment across sectors, and in a different level of investment expenditure in sectors.
8. Correlation coefficients between user costs of capital and capital usage (as embodied in the investment rate and growth in capital stock of Machinery & Equipment) suggests that over time, and for most sectors, the real user cost of capital seems to carry the potential of constituting at least one of the major determinants of investment expenditure in the South African economy – as would be anticipated by economic theory.

9. The user cost of capital appears to have formed a significant constraint on investment in real capital stock during the course of the 1970's, but the severity of this constraint declined during the course of the 1980's and 1990's. It could therefore be argued that the state in its effort to direct investment in South Africa may have raised the user cost of capital, and that the steady withdrawal of the state from the capital markets and increased reliance on market forces over time may have lowered such distortions. The negative association between magnitude and cost of investment noted for the 1970's is in line with economic theory, while the disappearance of this negative association may be a reflection of the negative sentiment generated by the increased levels of political uncertainty that has characterised the 1980's, and the political transition of the 1990's. In other words, the importance of the real user costs of capital as an explanatory variable of investment behaviour may to some degree have been eroded by the political uncertainty factor.
10. The descriptive analysis of capital productivity, defined here as the ratio of value added and capital stock of Machinery & Equipment, suggests that while the 1970's and 1980's showed strong deviations in the distribution of capital across sectors in the economy, such that the productivity of capital was strongly differentiated across sectors, subsequent reallocation of capital stock in the economy appears to have equalised the productivity of capital across sectors. From a theoretical point we would anticipate that more perfect capital markets would serve to equalise the marginal product of capital across sectors, thereby generating more efficient allocation of capital stock.
11. Examination of correlation coefficients between real user costs of capital and various measures of capital stock growth suggest the presence of declining investment rates in sectors as they conform less closely to the dictates of standard economic theory. In other words, where the real user cost of capital is less closely linked to real capital productivity, the growth in capital also tends to be lower. For purposes of policy intervention in South African capital markets, "well-functioning" capital markets, defined as those that more closely link factor rewards to factor productivity, are desirable as a means of stimulating investment expenditure in the fixed capital stock of the economy.
12. Evidence from the rate of return on capital variable, defined here as the ratio of gross operating surplus and capital stock is less conclusive. Any adequate explanation of investment in real capital stock will have to look beyond the real rate of return on capital stock, the correlation coefficient between the real rate of return and the growth rate in real capital stock across South African economic sectors shows wide divergence.
13. In addition, we examined capacity utilisation as an explanatory variable for investment behaviour. Except for a few outliers, it seems that South Africa's basic industries, at the lower end of the "value chain" are running at relatively high levels of capacity utilisation, while further downstream, the opposite conclusion can be drawn. However, the correlation coefficients between capacity utilisation, as a proxy for demand, and the various measures of capital stock growth does not seem to give much support to the accelerator mechanism.

Since we know investment expenditure to have a multivariate explanation, and ceteris is not paribus in the current context, the varied results of our descriptive analysis are perhaps not entirely surprising. Nevertheless, we believe that the exploratory analysis does lend credence to the presence of long run patterns of structural change in South African capital markets – played out over the full 1970-97 time frame. Moreover the 1990's mark a second structural break, with the sudden emergence into prominence of (some) manufacturing sectors as

leading investors, and the possibility that distortions to capital markets may have diminished over time, leading to a greater reliance on market forces.

Finally, the descriptive analysis suggests that where economic sectors are allowed to respond to market forces, in the sense that factor rewards are more closely linked to factor productivity, investment rates are likely to be more sustainable in the long run. The evidence examined for this study, suggests that for South African capital markets the link between factor rewards and productivity appears to be have been strengthening during the course of the 1990's. If correct, this can only auger well for the long term growth performance of the economy.

# Section 5: Investment in Machinery: the South African Manufacturing Industry 1970-1997[31]

### *5.1) Introduction*

With the data base and descriptive analysis in place we can now turn our attention to an attempt to estimate investment functions with special emphasis on the manufacturing complex. In doing so, we hope to examine the determinants of investment expenditure for manufacturing. While estimating investment expenditure functions would appear to be a straightforward exercise there is a considerable body of literature that suggests otherwise. A couple of issues therefore have to be dealt with before we can proceed with presenting econometric results. One issue concerns the theory of investment expenditure; another involves appropriate econometric estimation methodologies in the face of limited data.

It was clear from the previous section that the determinants of investment depend to a large extent on the specific sector, notwithstanding the overwhelming importance of certain variables to all sectors. But even a critical variable such as user cost of capital appears more significant to a certain cluster of sectors than it does to another. Indeed, a large part of the previous chapter looked at correlations. The aim here is to take the analysis one step further and to establish some more detailed statistical association between determinants of investment and investment for various clusters of sectors .

This section starts by reintroducing some of the theoretical discussion of the variables used in the econometric models of capital expenditure and explains why they are used in the South African context. We then continue with an outline of the methodologies concerning the estimation of such models after which we present results. We conclude this section with a summary.

### *5.2) Determinants of investment in the South African context*

Two particular variables that featured prominently as determinants of investment in the previous section are that of uncertainty and the user cost of capital. The importance of these variables was discussed at the outset but it may be useful to recap briefly what they entail.

*Uncertainty*

Irreversibility of investment decisions and the possibility of waiting, means that the decision not to invest at the present point in time can be thought of as the purchase of an option. The option has value since waiting to invest in an uncertain environment has information value also, and hence investing now rather than tomorrow has an opportunity cost associated with it. One of the core insights of the modern literature is that uncertainty generates a reward for waiting, and hence that increases in uncertainty will potentially lower investment. Thus, the modern literature on uncertainty identifies two countervailing effects on investment:

- a positive impulse through a rising profitability of investment (since investing may carry information),

[31] This section draws on the discussion found in Fedderke (2000).

– a negative impulse arising from the opportunity cost of investing now rather than in the future (since waiting may carry information)[32].

The net effect of uncertainty on investment is thus ambiguous, and a matter to be empirically determined[33].

Employing data for the South African manufacturing industry provides the opportunity for a useful extension to the debate on the investment-uncertainty nexus. As was noted in the previous section, South African manufacturing industry has faced sector specific uncertainty imparted by the impact of substantial government intervention in the form of "strategic" investment projects, some of which proved unsustainable in the long run, and carried implications for both the user cost of capital and the level of demand for the output of manufacturing sectors. But South African manufacturing has also seen strong fluctuation in the level of what we term "aggregate" or systemic uncertainty which emanated both from instability of the political dispensation[34], and from property rights that suffered from substantial restrictions until South Africa's very recent history (Fedderke, De Kadt & Luiz, 1999a). The analysis presented in this section has at its disposal unique data allowing for a clear identification of the systemic uncertainty in South Africa, both economic and institutional, thus allowing a deepening of our understanding of the impact of this type of uncertainty on a sectoral level.

*User Cost of Capital*

The real user cost of capital is seen to be statistically significant as a determinant of investment rates in South African manufacturing industry. The implication of this is twofold. In the first instance the impact of factors that change the user cost of investment such as high taxation rates for instance act as a deterrent to investment. The corollary is that policy makers play a role in creating the appropriate conditions for rising investment rates through an alteration of the real user cost of capital. But equally, the real user cost of capital is only one of a number of determinants of investment. This implies that for policy makers a simple focus on the user cost of capital is not enough. A number of additional explanatory variables are also investigated.

[32] As discussed in section 2.5 above, the modern literature recognises a further reason why higher uncertainty may increase rather than lower investment expenditure. Higher uncertainty serves to raise the threshold level of profitability that must be satisfied in order to trigger investment expenditure, and the expectation might thus be of lower investment. However, uncertainty may also raise the volatility of profit flows, such that the higher threshold level of profitability is satisfied more frequently than in a certain environment, generating more frequent bursts of investment expenditure.

[33] A comprehensive coverage of the modern debate can be found in Dixit & Pindyck (1994) while Price 1995) also provides a useful introduction to the issues. See also Fedderke (2000).

[34] Even the long-awaited democratic transition has not entirely settled such uncertainty, since any new political order requires time in order to develop and settle into the new informal and implicit rules of the game.

*Credit Rationing*

Thus far we have implicitly assumed that both output and financial markets are perfectly competitive. Modification of these assumptions carries additional implications for the specification of the investment function. Moreover, the South African context introduces a number of specialised conditions that could conceivably exert influence on investment expenditure. The presence of credit rationing in financial markets may drive a wedge between the cost of internal and the cost of external finance. One response to this problem is the cash flow model of investment that hypothesises that investment is a function of firms' (and hence, by aggregation, the industries') internal cash flow. The justification lies in the presumption that firms face liquidity constraints, so that internal sources of funds are subject to a lower opportunity cost than the interest rate on external funding would imply (see Jorgenson & Siebert, 1968 :685)[35]. Traditionally the liquidity theory has not found much favour either on theoretical grounds, since financial constraints were not considered important for investment, or empirically[36]. The counter argument is that credit rationing has been found to be non-trivial (though for good asymmetric information reasons), and that credit rationing might be particularly severe for a developing country context such as South Africa (see also Collier & Gunning, 1999). We will undertake some testing of whether financial constraints are likely to have been of significance in South African manufacturing industry. We do so by controlling for the magnitude of internal funds potentially available to industries – using the real gross operating surplus for this purpose.

*Demand*

Where output markets are no longer perfectly competitive, the magnitude of output may come to exercise an influence as a proxy for aggregate demand. Thus in effect we introduce the accelerator principle into the determination of investment expenditure. The accelerator principle has a long history, and has the merit of simplicity. Jorgenson & Siebert (1968) points out that the accelerator proposes that investment is related to capacity utilisation. The suggestion is that the desired capital stock of a firm (and hence, by aggregation an industry) stands in a constant, and technically determined relation to the level of output to be produced. Abel & Blanchard, 1988 point to a number of sources of lags, including expectations, costs of adjustment, delivery lags, and financial. The presumption remains that the capital-output ratio remains constant over time, perhaps fixed by the technology of production. While often applied in the empirical literature, the model does carry limitations. Chief of these are that the assumption of a constant capital-output ratio is restrictive, while estimation of the framework as a distributed lag model (as has historically been the case) is arbitrary. But perhaps most significantly, the use of the technically determined capital-output ratio, or the capital-output ratio which at the very least does not take explicit account of a comparison of marginal returns and costs underlying the investment decision, obscures the most important economic questions surrounding investment. A better justification for the use of output in the determination of investment lies in the importance of aggregate demand relevant to firms that possess some market power. See also the discussion in Fielding (1997 & 1999). An alternative means of controlling for the impact of aggregate demand on investment might be to control directly

[35] The differential cost between internal and external sources of funding is due to a number of factors, including adverse selection and moral hazard problems. Nevertheless, even where such constraints are granted as being of potential significance for investment expenditure, the approach fails to provide a comprehensive microeconomic foundation in the maximising behaviour of firms for investment.
[36] The Miller-Modigliani theorem explains why financial constraints might be considered unimportant. However, Gilchrist & Himmelberg (1998) argue that financial variables may be important even if capital market imperfections are not present, since they may contain information about the expected marginal value of capital. They present empirical results confirming their interpretation.

for the level of capacity utilisation in each sector, although we must be careful here. The use of the capacity utilisation variable in the report which follows refers not to demand factors, but to the expected value of output.

*Trade liberalisation*

In an examination of the impact of trade and trade liberalisation on South African labour markets using the Stolper-Samuelson framework, Fedderke Shin & Vaze(1999) show that labour usage in the South African economy was materially affected. In particular, they find that in accordance with the predictions of the Stolper-Samuelson theorem, trade and its liberalisation positively affected the demand for the abundant factor of production in the South African manufacturing sector, viz. labour. The corollary is therefore that the demand for the scarce factor of production might have been negatively affected by trade. We therefore examine the trade impact in the empirical examination of South African investment rates.

*Technology*

In the same study, Fedderke Shin & Vaze (1999) also note that technological progress exercised a negative influence on labour usage in the South African manufacturing sector. Again, therefore, the question in the present context is whether technology exerted any impact on the demand for capital stock. We therefore examine the impact of technological progress on investment rates in the empirical examination of South African investment rates.

*Labour*

Capital and labour are often viewed as substitutes. To investigate this view we will control for the change of real labour remuneration. In doing so, we are able to examine whether relative factor prices drive investment expenditure. While capital and labour are often viewed as substitutes, we also test for the possibility that investment in fixed capital may be dependent on the sufficient availability of skilled labour. We do so by means of controlling for the ratio of skilled to unskilled workers in the workforce of manufacturing sectors. While not having a strong prior in this regard, should clear complementarities between skilled labour and the expansion of fixed capital stock be present, we would expect the sign on the skills ratio to be positive. In other words, a relatively more skilled labour force is expected to result in a higher investment expenditure.

*Rate of Return*

In the previous section we pointed at the possible hypothesis that the rate of return on capital may be relevant as an explanatory variable. Again in the estimation stage of the present study we test explicitly for the impact of the rate of return on capital stock on investment rates.

*Public Sector Infrastructure Investment*

One final consideration arises. A number of authors have argued that government investment expenditure results in the crowding in of private sector investment expenditure - see for instance the discussion in Adelzadeh (1996). As a consequence we attempt to establish whether such a crowding in effect is present for South African manufacturing industry.

***5.3) Econometric methodology***

The estimation of capital expenditure functions for South Africa in this section makes use of panel data. This refers to the pooling of observations on a cross-section of households, countries, firms, sectors, etc. over several time periods, thereby increasing the number of observations and thus potentially also statistical power. The estimation techniques available to analyse such data have attracted much interest in econometric research and there are a variety of estimation techniques that may be applied to panels. The methodologies vary across the dimensions of the panel and with respect to the modeller's prior belief about how such a system works. Generally, a long panel has the advantage that the long-run economic relationships of the modelled system can be estimated. The number of time periods can be referred to using *T* with the size of the cross-section being *N*. If N is one, then the traditional method is to estimate an autoregressive distributed lag (ARDL) model. This has recently been superseded by techniques based around cointegration[37]. Both techniques have the advantage that they provide an estimate of the long-run relationship between the economic variables. When *N* is small, the chosen method is usually the seemingly unrelated regression equation (SURE) technique. This is similar to running ordinary least squares on each of the panel categories but allowing for some covariance in the error terms across the categories. The data set used in this report is a panel of 28 sectors annually over the period 1970-97. This is a balanced panel in the sense that *T* and *N* are of similar magnitudes. This allows the use of techniques to estimate a long-run equilibrium relationship while at the same time modelling the heterogeneous short-run dynamics that may be exhibited across the *N* groups in the panel. A number of techniques will be used here. However, these will be used with reference to the pooled mean group (PMG) estimator, proposed in Pesaran (1997:433).

*Econometric Techniques*

The number of panel methods available to the econometrician has seen a large increase in recent years reflecting the diverse standpoints of time-series and cross-sectional specialists. In this section four methodologies are outlined:

1. the static fixed effect model (SF) model,
2. the dynamic fixed effect (DF) model
3. the pooled mean group (PMG) estimator
4. the mean group (MG) estimator.

The first of the methods is the most basic panel methodology; the latter methods improve on the treatment of the time-series dimension of the panel. This is done through more explicit consideration of two aspects of the time-series behaviour of the data across the panel: the short-run dynamics and the long-run equilibrium relationship. Moreover, while all of the DF, PMG and MG techniques allow for the estimation of both the short run and the long run equilibrium relationships present in the data, they also allow for heterogeneity between the groups (here sectors) present in the panel. Indeed, the three estimation methods differ in terms of the nature of the heterogeneity that they admit. Table 5.1 specifies the nature of the heterogeneity

[37] It should be noted though that cointegration and ARDL are not mutually exclusive. Thus Fielding (1999)] and Hartman (1972) outline an ARDL approach to cointegration.

present in the estimation approaches. For a more detailed exposition of the econometric estimation techniques, see Fedderke (2000).

Table 5.1: Panel Methodologies

| | Panel methodology | Dynamics modelled | Long-run relationship across panel | Short-run relationship across panel |
|---|---|---|---|---|
| 1 | Fixed effect | No | N/A | N/A |
| 2 | Dynamic fixed effect | Yes | Homogeneous | Homogeneous |
| 3 | Pooled mean group | Yes | Homogeneous | Heterogeneous |
| 4 | Mean group | Yes | Heterogeneous | Heterogeneous |

*The empirical models to be estimated*

In section 2 we have encountered a number of theoretical approaches to the modelling of the determinants of investment expenditure. These models require translation into empirical models, however, either in order to provide specificity to general functional forms, or in order to provide specifications in terms of observable magnitudes. In the case of what we term the "basic model" or the Jorgenson approach, the implication is that the desired capital stock of the firm depends on the ratio of expected output to the real user cost of capital. It can be shown (Fedderke, 2000) that an empirically testable investment equation can be written as:

$$I_t = d\ln K_t^* = a_0 + a_1 d\ln Y_t + a_2 d\ln uc_t \tag{5.1}$$

In which $I_t$ is net domestic investment, $K_t^*$ the stock of capital, $Y_t$ is the real gross value of production and $uc_t$ is the real cost of capital. Since an increase in output serves to raise the anticipated rate of return on capital, while an increase in the user cost of capital raises the marginal cost of investment, the anticipation is that $a_1$ is positive, and that $a_2$ be negative.

Empirical applications of irreversible investment models must control for the impact of uncertainty on the user cost of capital - see for example Ferderer (1993), Guiso & Parigi (1999) and Price (1995). One means of proceeding is to allow for an explicit impact of uncertainty on the investment relation. Thus using a starting point similar to the Jorgenson base model, it can be shown that we can write:

$$I_t = d\ln K_t^* = b_0 + b_1 d\ln Y_t^e + b_2 d\ln uc_t + b_3 f_t + b_4 Z_t \tag{5.2}$$

where $f$ denotes uncertainty and $Z_t$ a vector of additional controls. The theoretical discussion of section 2 has emphasised that the sign of the $b_3$ parameter is ambiguous a priori, and is to be determined empirically. The $b_1$ and $b_2$ coefficients carry the same implications as the symmetrical coefficients for the Jorgenson model. In the estimation section that is to follow our concern will be more with the estimation of equation (5.2) and its long run formulation which will allow the formulation of an error correction specification.

The specification provided by equation (5.2) explicitly permits us to control for some of the additional factors we introduced as being of potential importance in the South African context. As in the previous section, our

measure of investment is restricted to fixed capital stock strictly defined, and is given by net changes in the stock of machinery and equipment of South African three digit manufacturing sectors. The user cost of capital is that computed for manufacturing sectors in Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b), and incorporates the impact of the real domestic short term interest rate, the depreciation rate of capital stock, and the corporate tax rate. The output measure to enter both equations is the expected change of output as a means of controlling for the expected rate of return on fixed capital - an unobservable magnitude. Various studies deal with this unobservable magnitude in different ways. In some, the actual current change in output is employed (see for example Ferderer, 1993). In others an econometric construct is employed in order to represent expected changes in output. For instance Price (1995) employs a measure of capacity utilisation, defined as the deviation of actual from capacity output, such that output in excess of capacity will trigger investment. In the present report we employ a measure of the $d \ln Y_t^e$ by using the log change in the capacity utilisation variable.

Finally, we employ a new measure of uncertainty not previously available to research on South Africa. Appropriate measures of risk and estimation in their presence are again the subject of an independent literature (see Engle et al (1987) and Pagan & Ullah (1988)[38]. In the present study we employ a measure of systemic uncertainty provided by an index of political instability obtained from Fedderke, De Kadt & Luiz (1999a) as the measure of systemic uncertainty.

As discussed in section 5.3 above, we also test for the impact of the additional factors deemed to be of potential importance in the South African context:

- The impact of credit rationing we control for by testing the significance of a substitute for the availability of internal funding. This is proxied for by the log of the real gross operating surplus.
- Openness of a sector we control for by the ratio of the sum of imports and exports to total value added of the sector.
- Rate of return on capital stock. This is proxied for by the ratio of the real gross operating surplus to total capital stock.
- Technological progress we obtain from a sectoral measure of total factor productivity growth, computed from factor shares in output (see Fedderke, Henderson, Kayemba, Mariotti & Vaze (1999b).
- Relative factor price are controlled for by the log change of real labour remuneration.
- The skills intensity of the labour force composition, is obtained from the ratio of highly skilled and skilled workers, to unskilled workers in each manufacturing sector[39].
- We test for the impact of possible government crowding in by the magnitude of government investment expenditure.

[38] In order to obtain a measure of user cost uncertainty Ferderer (19993) employs a risk premium imputed to market interest rate on the basis of an ARCH representation of the spot market yield. In related vein, Price (1995)] employs a GARCH representation of the conditional variance of output as a measure of output uncertainty.
[39] Note that data for Tobacco, Plastics, TV, Radio & Communications Equipment, and Other Transport Equipment does not have the skills composition of the labour force data available. These sectors are therefore excluded from the relevant estimations.

***5.4) Estimation Results***

With the theoretical and empirical model and the data base in place we can now proceed with the estimation of investment expenditure functions.

*Base model estimation: the Jorgenson model*

In the first set of estimations the base model specified by equation (5.1) is estimated in order to provide a reference point for more complete specifications. We regress the investment rate against the log change of capacity utilisation and the log change of the user cost of capital. All variables are defined for the 28 manufacturing sectors of the economy, and are available over the 1970-97 period.

Table 5.2 reports the results. Note that the speed of adjustment coefficient in all three dynamic panel estimation techniques implies the presence of an equilibrium relationship. Moreover, except for the DF estimate, adjustment to long run equilibrium is rapid, in the sense that a large proportion of any disequilibrium that appears in any given year, is eliminated in the following year (ranging between 57% and 75%). A number of important implications immediately follow from the evidence. The overriding one is that the base model clearly faces difficulty in explaining South African investment rates. In none of the specifications is the user cost of capital significant as a determinant of investment rates. Note further that the change in capacity utilisation variable is significant only in the PMG dynamic estimation and in the static fixed effects estimation. Thus the evidence fails to conform to the prior expectations that flow from the base Jorgenson-style model, and it is difficult to accord much confidence to any explanation of investment rates in South African manufacturing industry that does not admit of adjustment costs in the movement of actual to desired capital stock levels.

Table 5.2: Alternative panel data estimates for ARDL(2,2,2) - based Jorgenson model [equation (5.1)] for South African manufacturing sectors over the period 1972-1997

| | Mean Group (MG) | Pooled Mean Group (PMG) | Dynamic Fixed Effect (DF) | Static Fixed Effect (SF) |
|---|---|---|---|---|
| Long-run coefficient on capacity utilisation ($\alpha_1$) | -.33 (.69) | .42* (.13) | .27 (.45) | .16* (.04) |
| Long-run coefficient on user cost of capital ($\alpha_2$) | -.25 (.17) | -.01 (.02) | .20 (.12) | .02 (.01) |
| Speed of adjustment coefficient | -.65* (.11) | -.75* (.08) | -.57* (.16) | |
| Hausman test for long-run homogeneity | | 2.69 [.26] | | |
| Log likelihood ratio test for long-run homogeneity | | 74.0* [.03] | | |

*Source: Fedderke (2000). Note: figures in round parentheses denote standard errors, in square parentheses probability levels*

Our Jorgenson reference point thus points to the need for more complete models of investment expenditure in South Africa's manufacturing sector. The neoclassical model of investment expenditure alone does not suffice. Hence it is to specifications that admit of adjustment costs and the impact of uncertainty that we turn at this point.

*Irreversibility model of investment: the impact of uncertainty*

This section presents results from estimations that account for the impact of uncertainty on investment rates, as specified in equation (5.2). We regress the investment rate against the log change of capacity utilisation, the log change of the user cost of capital, and a measure of systemic uncertainty. The uncertainty measure is provided by a logged index of political instability for South Africa obtained from Fedderke, De Kadt & Luiz(1999a). All

variables except the political instability index are defined for the 28 manufacturing sectors of the economy individually, and are available over the 1970-97 period.

Table 5.3: Alternative panel data estimates for ARDL(2,2,2,2) - based irreversibility model [equation (5.2)] for South African manufacturing sectors over the period 1972-1997

| | Mean Group | Pooled Mean Group | Dynamic Fixed Effect | Static Fixed Effect |
|---|---|---|---|---|
| Long-run coefficient on capacity utilisation ($b_1$) | -3.28 (3.57) | .58* (.21) | .14 (.31) | .03 (.04) |
| Long-run coefficient on user cost of capital ($b_2$) | -.42 (.33) | -.13* (.03) | -.26 (.14) | -.04* (.02) |
| Long-run coefficient on uncertainty ($b_3$) | -.07* (.03) | -.04* (.00) | -.06* (.02) | -.04* (.01) |
| Speed of adjustment coefficient | -1.07* (.11) | -.72* (.09) | -.62* (.18) | |
| Hausman test for long-run homogeneity | | | | |
| Log likelihood ratio test for long-run homogeneity | | 187.7* [.00] | | |

*Source: Fedderke (2000). Note: figures in round parentheses denote standard errors, in square parentheses probability levels*

Table 5.3 reports the results. Again the speed of adjustment coefficient implies the presence of a long run equilibrium relationship for all dynamic specifications, and again adjustment to equilibrium is rapid, indeed more so than for the Jorgenson specification. While for the DF and MG estimates the change in capacity utilisation and user cost variables remain insignificant, note that the PMG estimates now imply theoretically coherent results. Not only do the results confirm a significant response of investment rates to changes in capacity utilisation (as a proxy for $d \ln Y_t^e$), but the expected negative and significant sign on the user cost of capital variable is found to be present. Finally, we find a negative and significant impact to attach to our measure of systemic risk - a finding that generalises across all estimation. This finding of a negative and significant impact of uncertainty on investment is not only consistent with the majority of international evidence, but conforms to the findings of Fielding (1997 & 1999) on South Africa[40].

However, there are non-negligible differences in the results obtained from the alternative dynamic panel estimation techniques. Under such circumstances, our preference is for the use of the PMG estimation. The main justification for this choice is that when there is some variation among alternative estimation techniques, PMG estimator offers an intermediate option, in which heterogeneity is admitted into estimation, while the opportunities to improve the power of statistical estimations offered by panel estimation continue to be realised.

[40] There may be some question about the use of the political instability index as a measure of uncertainty. Since the index is explicitly a weighted average of a range of political variables, whose weighting was determined by the professional opinions of political scientists, sociologists and legal experts on South Africa. More specifically, there may be some concern that:

1. the index does not capture all sources of uncertainty relevant to economic activity. In particular, the uncertainty that emerges from the state of labour relations is not controlled for in the political uncertainty index. Fielding's studies (1997 & 1999) are distinguished from the present study in part because of the use of uncertainty measures based on labour unrest.
2. the index may come to reflect subjective bias.

In order to test the sensitivity of our results to the use of alternative measures of systemic uncertainty, we replaced the political instability index by the following additional measures:

- A measure of labour unrest given by the total number of workers involved in strike activity per annum, published by the South African Reserve Bank.
- A measure of labour unrest given by the total number of person days lost due to strike activity per annum, published by the South African Reserve Bank.
- A measure of aggregate uncertainty, composed of a weighted average of the political instability index already employed, and the measure of labour unrest given by the total number of workers involved in strike activity per annum.
- A measure of aggregate uncertainty, composed of a weighted average of the political instability index already employed, and the measure of labour unrest given by the total number of person days lost due to strike activity per annum.

The advantage of these measures is first that they explicitly include labour unrest in the uncertainty measure, and second that they provide a clear objective ground to the uncertainty measure. In re-estimating our investment functions that included these alternative measures of uncertainty, we found that in all instances the alternative measures of uncertainty remained of negative sign, and strongly statistically significant. (Full results are available from the author on request). We therefore conclude that the inference drawn in the study around the nature of the impact of uncertainty is not sensitive to the inclusion of labour unrest in the measure of uncertainty.

With respect to the static fixed effects estimation, PMG estimates are more efficient on theoretical grounds (incorporating as they do dynamics), but the results presented in Table 5.3 are also theoretically more coherent given the inability of the static fixed (SF) effects estimate to establish significance on the user cost of capital variable. Our preferred results are thus those obtained from the PMG estimates. The implication of these estimates is that:

- a 1% increase in the growth rate of capacity utilisation would lead to a 0.58 percentage point increase in investment.
- a 1% increase in the growth rate of the user cost of capital would lead to a 0.13 percentage point fall in investment.
- a 1% increase in the systemic uncertainty variable would lead to a 0.04 percentage point fall in investment.

As a final note, while we have a preference for PMG estimates, use of the MG estimates allows us to obtain some insight into the individual sectoral estimates on the three model coefficients. What emerges from these findings is that groups within the panel are heterogeneous with respect to the parameters of the model. Table 5.4 reports the sectoral results for the benefit of the reader. Thus for instance the Coke & Refined Petroleum sector has a -95.43 $b_1$ -coefficient[41] and eight further sectors potentially have the theoretically unsupported $b_1 < 0$ finding[42]. Similarly, there are eight sectors for which it appears that $b_2 > 0$. However, note that there are very few sectors with a nonnegative $b_3$ coefficient[43].

[41] Exclusion of the sector from estimation does not affect results materially.
[42] Beverages, Textiles, Basic Chemicals, Other Chemicals, Rubber, Basic Non Ferrous Metals, Metal Industries, Instruments.
[43] Estimating by splitting the panel into the implied groupings of sectors tends to confirm the signs of the relevant coefficients for each group as a whole.

Table 5.4: Group-specific estimates of the long-run coefficients based on ARDL specifications with pre-specified lags

| | speed of adjustment | capacity utilisation | user costs of capital | uncertainty |
|---|---|---|---|---|
| | $f$ | $b_1$ | $b_2$ | $b_3$ |
| 1 Food | -1.937 | 1.151 | -0.088 | -0.028 |
| | (0.670) | (1.716) | (0.091) | (0.010) |
| 2 Beverages | -1.855 | -2.148 | -0.163 | -0.032 |
| | (0.725) | (0.946) | (0.115) | (0.012) |
| 3 Tobacco | -0.713 | 0.212 | 0.009 | -0.001 |
| | (0.200) | (0.210) | (0.029) | (0.003) |
| 4 Textiles | -0.893 | -0.200 | -0.064 | -0.001 |
| | (0.560) | (0.346) | (0.106) | (0.006) |
| 5 Clothing & wearing apparel | -0.408 | 3.261 | 0.048 | -0.017 |
| | (0.296) | (2.759) | (0.076) | (0.011) |
| 6 Leather & leather products | -2.112 | 0.190 | -0.020 | -0.009 |
| | (0.683) | (0.492) | (0.027) | (0.002) |
| 7 Footwear | -0.715 | 0.527 | -0.072 | -0.014 |
| | (0.998) | (1.227) | (0.106) | (0.016) |
| 8 Wood & wood products | -0.598 | 0.968 | -0.044 | -0.026 |
| | (0.530) | (1.394) | (0.108) | (0.022) |
| 9 Paper & paper products | -1.229 | 6.194 | 0.212 | -0.053 |
| | (0.349) | (3.788) | (0.214) | (0.017) |
| 10 Printing, publishing & recorded media | -1.250 | 0.741 | -0.103 | -0.031 |
| | (0.498) | (1.918) | (0.117) | (0.014) |
| 11 Coke & refined petroleum products | -0.224 | -95.656 | -8.839 | -0.897 |
| | (0.278) | (151.185) | (13.080) | (1.146) |
| 12 Basic chemicals | -0.477 | -6.472 | -0.858 | -0.104 |
| | (0.173) | (4.158) | (0.531) | (0.041) |
| 13 Other chemicals & man-made fibres | -0.574 | -2.290 | -0.197 | -0.068 |
| | (0.364) | (4.401) | (0.302) | (0.046) |
| 14 Rubber products | -0.843 | -1.964 | -0.184 | -0.044 |
| | (0.519) | (2.948) | (0.253) | (0.027) |
| 15 Plastic products | -0.562 | 1.694 | 0.020 | -0.065 |
| | (0.464) | (4.952) | (0.300) | (0.054) |
| 16 Glass & glass products | -1.592 | 0.282 | 0.040 | -0.014 |
| | (0.245) | (0.514) | (0.114) | (0.008) |
| 17 Non-metallic minerals | -1.125 | 1.016 | 0.123 | -0.050 |
| | (0.304) | (0.790) | (0.132) | (0.015) |
| 18 Basic iron & steel | -1.650 | 1.780 | -0.190 | -0.077 |
| | (0.362) | (1.590) | (0.242) | (0.021) |
| 19 Basic non-ferrous metals | -0.968 | -2.349 | -0.372 | -0.039 |
| | (0.275) | (1.853) | (0.262) | (0.014) |
| 20 Metal products excluding machinery | -2.059 | -0.078 | -0.040 | -0.008 |
| | (0.539) | (0.184) | (0.027) | (0.002) |
| 21 Machinery & equipment | -2.068 | 0.105 | 0.013 | -0.005 |
| | (0.787) | (0.155) | (0.025) | (0.002) |
| 22 Electrical machinery | -0.777 | 0.329 | -0.081 | -0.020 |
| | (0.291) | (0.588) | (0.092) | (0.008) |
| 23 Television, radio & communication | -1.223 | 0.889 | -0.027 | -0.022 |
| | (0.347) | (0.649) | (0.096) | (0.007) |
| 24 Professional & scientific equipment | -0.458 | -0.705 | -0.079 | -0.030 |
| | (0.337) | (1.291) | (0.139) | (0.023) |
| 25 Motor vehicles, parts & accessories | -0.855 | 0.666 | 0.030 | -0.037 |
| | (0.688) | (1.056) | (0.175) | (0.029) |
| 26 Other transport equipment | -1.416 | 1.446 | -0.163 | -0.038 |
| | (0.477) | (1.405) | (0.169) | (0.015) |
| 27 Furniture | -0.349 | 1.639 | -0.110 | -0.041 |
| | (0.495) | (2.964) | (0.269) | (0.061) |

*Source: Fedderke (2000). Note: figures in round parentheses denote standard errors*

Although similar results are available (on request) for any of the specifications examined in the study, we cannot use the coefficients so estimated directly as a means of obtaining information about individual sectors, and then formulating policy in accordance with these findings for a number of reasons. A brief consideration of the sectoral results quickly establishes that a number of sectors have theoretically questionable signs on both variables. For instance, the Beverages and Textiles sectors (amongst others) have a negative sign on the capacity utilisation (*dutil)* variable, while the Tobacco and Paper sectors (again amongst others) have a positive sign on the user cost (*duc)* variable. The technical reason for this is that the results shown in the table rest on the Mean Group estimator, which estimates the investment function for each sector separately. Such estimation has low power in the current context, because of the small number of observations available for each sector. This is explained in greater detail in Appendix 5B.

Nevertheless, there is some evidence of heterogeneity in the panel under investigation. In order to develop a better understanding of such heterogeneity, one possibility might be to identify subgroups within the total manufacturing sectors according to clearly identifiable a priori criteria. This allows us to establish whether the coefficients on the respective investment functions for such groups are heterogeneous. One such classification might be the following:

Table 5.5: Cluster description

| Cluster | | Sectors |
|---|---|---|
| 1. | Wage Goods | Food, Beverages, Tobacco, Textiles, Apparel, Leather, Footwear, Furniture. |
| 2. | Resource Intensive Goods | Wood, Paper, Coke & Petroleum Products, Basic Chemicals, Other Chemicals, Rubber, Glass & Glass Products, Non Metallic Minerals, Basic Iron & Steel, Basic Non Ferrous Metals. |
| 3. | Fabricated Manufactures | Printing, Plastics, Fabricated Metals, Machinery & Apparatus, Electrical Machinery, Radio, TV & Comms Equipment, Instruments, Motor Vehicles & Accessories, Transport Equipment, Other Manufacturing & Recycling. |

The classification is open to debate with Furniture an outlier in the wage good cluster, as it includes office furniture, and similarly, Printing, including recorded media, in the fabricated manufacturers cluster. The grouping presented above should be seen as a starting point for further discussion, rather than as a definitive clustering. A regrouping of clusters can easily be considered on the basis of cross sectional research that is currently undertaken in a parallel investigation on investment behaviour. The results from the PMG estimations for the three clusters are reported in Table 5.6. What emerges from the grouped manufacturing sector estimations is evidence of some strong sectoral differences.

Table 5.6: Pooled Mean Group (PGM) estimates for ARDL - based irreversibility model [equation (5.2)] for South African manufacturing cluster over the period 1972-1997

| | Wage goods | Resource based goods | Fabricated manufactures |
|---|---|---|---|
| Long-run coefficient on capacity utilisation ( $_1$) | 1.25* (.47) | .59 (.37) | .37 (.23) |
| Long-run coefficient on user cost of capital ( $_2$) | -.06 (.03) | -.09 (.06) | -.10* (.04) |
| Long-run coefficient on uncertainty ( $_3$) | -.02* (.00) | -.05* (.01) | -.03* (.00) |
| Speed of adjustment coefficient | -.80* (.11) | -.91* (.17) | -.84* (.16) |
| Log likelihood ratio test for long-run homogeneity | 61.06* [.00] | 61.17* [.00] | 34.30 [.16] |

*Source: Fedderke (2000). Note: figures in round parentheses denote standard errors, in square parentheses probability levels*

First, of the three groupings of manufacturing sectors Wage Goods sectors are the most responsive to changing demand factors, with a 1% increase in the growth rate of capacity utilisation leading to a 1.25 percentage point increase in the investment rate. By contrast, neither the Resource Intensive grouping of manufacturing sectors, nor the Fabricated Goods grouping of sectors show a statistically significant response of the investment rate to a changing growth rate of capacity utilisation.

Second, only the Fabricated Goods grouping of manufacturing sectors shows a statistically significant response to changes in the user cost of capital, with a 1% increase in the growth rate of the user cost of capital generating a 0.1 percentage point fall in the investment rate. Neither the Wage Good nor the Resource Intensive Good sector show a statistically significant responsiveness of investment rates to changes in our measure of the user cost of capital. (one impact of uncertainty on investment expenditure may well be to render the user cost of capital variable less significant – see the discussion in Fedderke (2000). For two groupings of sectors this possibility thus appears to be at least plausible

Third, all three manufacturing sector groupings are sensitive to uncertainty - indeed in this dimension the three sector groupings are the most homogeneous. However, the Resource Intensive sectoral grouping proves to be not only the most sensitive to the impact of uncertainty, but for this grouping of sectors uncertainty seems to dominate all other determinants of the investment rate. Thus a 1% increase in systemic uncertainty for these sectors leads to a 0.06 percentage point decline in the investment rate, compared to a 0.03 percentage point decline for Fabricated Goods, and a 0.02 percentage point decline for Wage Goods.

Finally, we note that the adjustment to equilibrium is of differential speed between the three sectoral groupings. Hence, for the Resource Intensive sectoral grouping 91% of any disequilibrium will be eliminated in the year subsequent to its occurrence, while for the Fabricated Goods grouping only 84% of such a disequilibrium is eliminated, and for the Wage Goods sectors this falls to 80%. The implication of this finding is that should any policy intervention leading to an alteration in the equilibrium investment rate, be undertaken, the Wage Goods sectors will respond most slowly, the Resource Intensive sectors most quickly to such changes, with Fabricated Goods sectors being of intermediate responsiveness.

The central finding of the present section remains that uncertainty exercises not only a statistically significant effect on investment rates, but that it does so almost without exception on all manufacturing sectors in South Africa even where we allow for the presence of heterogeneity across groups included in estimation. Moreover, the effect of uncertainty on investment is unambiguously such as to lower investment rates.

*Irreversibility model of investment; considering the impact of additional variables*

As a final exercise, we investigate the impact of the additional potential determinants of investment expenditure in the South African manufacturing sector listed in 5.3 above. The specification is again provided by equation (5.2). The $b_1$ coefficient continues to refer to the $d \ln Y_t^e$ variable, and we continue to proxy for this by the log change in capacity utilisation. For the sake of parsimony, we report only the results obtained from PMG estimation[44]. In Table 5.7 we report estimation results, in each instance specifying the $Z_t$ being controlled for[45].

[44] We have already explained the reason for the preference for the PMGE results. Full results are available from the author of Fedderke (2000) on request.

[45] Ideally we might have wished to control for a range of these additional dimensions at once. Unfortunately the limited number of observations per group included in observations, and the use of an ARDL framework places limits on this. Hence we report only on the results after inclusion of each additional regressor, to preserve comparability. Further, the GAUSS algorithm does not allow for the inclusion of two reference variables (unvarying across groups) hence the exclusion of the political instability variable in the estimation controlling for government investment expenditure.

Table 5.7: Pooled Mean Group (PGM) estimates for ARDL - based irreversibility model [equation (5.2)] additional over the period 1972-1997

| Description of additional variable | Speed of adjustm $f$ | Capacity utilisation $b_1$) | User costs of capital $b_2$) | Uncert-ainty $b_3$) | Additional variable $b_4$) | Data source of additional variable |
|---|---|---|---|---|---|---|
| Credit rationing<br>LR= 286.49* [.00] | -.63*<br>(.09) | .67*<br>(.25) | -.12*<br>(.03) | -.05*<br>(.00) | .05<br>(.05) | log of real gross operating surplus |
| Trade openness<br>LR= 332.76* [.00] | -.73*<br>(.10) | .36<br>(.20) | -.16*<br>(.03) | -.04*<br>(.00) | .003<br>(.008) | ratio of sum of imports and exports to value added |
| Technological progress<br>LR= 316.22* [.00] | -.75*<br>(.09) | .63*<br>(.20) | -.13*<br>(.03) | -.04*<br>(.00) | -.02<br>(.06) | growth in total factor productivity at the sectoral level |
| Skill composition<br>LR= 231.57* [.00] | -.68*<br>(.11) | .59*<br>(.24) | -.13*<br>(.04) | -.05*<br>(.00) | -.08*<br>(.02) | log ratio of skilled of unskilled labour |
| Rate of return on capital<br>LR= 336.73* [.00] | -.62*<br>(.08) | .85*<br>(.26) | -.14*<br>(.04) | -.05*<br>(.01) | .09*<br>(.03) | log change of net operating surplus to fixed capital stock |
| Real cost of labour<br>LR= 290.73* [.00] | -.68*<br>(.09) | .68*<br>(.23) | -.14*<br>(.03) | -.05*<br>(.00) | -.06<br>(.21) | log change of real remuneration per worker |
| Government crowding in<br>LR= 93.59 [.16] | -.71*<br>(.08) | .82*<br>(.23) | -.02<br>(.02) | | .04*<br>(.02) | log of the level of real government investment expenditure |

*Source: Fedderke (2000). Note: figures in round parentheses denote standard errors, in square parentheses probability levels*

We note immediately that for all specifications the speed of adjustment coefficient continues to confirm the presence of a long run equilibrium relationship amongst the variables included in estimation. Moreover, for all specifications the proxy for $d \ln Y_t^e$ continues to maintain its positive and significant coefficient[46], while the real user cost of capital variable has the expected negative and significant sign[47], and the impact of systemic uncertainty remains consistently negative and significant. In the case of both the real user cost and the systemic uncertainty variables, the size of the coefficients attaching to the variables also remains relatively constant in the face of alternative specifications of the investment function.

The results obtained from the central model of investment with irreversibility thus appear robust to changes in specification of the investment equation. Additional conclusions to emerge from the results of the present section thus focus on the coefficients of the various $Z_t$ included in estimation. The additional regressors included in estimation fall into two groups, i.e., those that prove significant, and those that do not. Amongst the latter, is the proxy for the impact of credit rationing on investment. The implication thus appears to be that credit rationing is not a constraint for South African manufacturing industry[48]. Technological progress per se also does not appear to have influenced the investment rate in manufacturing industry significantly[49]. One interpretation of this is that the impact of technology is exercised through the impact of the variables proxying for the rate of return and marginal cost of capital.

Openness also does not appear to have significantly affected the investment rate of the South African manufacturing sector. One interpretation that can be attached to the insignificance of the openness variable is

[46] The one exception is the specification controlling for the aggregate openness of the sector
[47] Except in the equation controlling for government crowding in
[48] Of course provided the proxy employed can be considered acceptable. A second consideration here is that since the data set is based on firms that are included in Stats SA's manufacturing survey frame, small and medium sized firms may be underrepresented in the sample on which the data is based. This might serve to understate the impact of credit rationing.
[49] In Fedderke, Shin & Vaze (1999) it was found that the impact of technological progress on labour usage was negative over the 1970-97 period. This may appear to be in potential conflict with the finding that technology exercised no influence on investment rates in capital stock. This is only apparently the case, however. The finding in Fedderke Shin & Vaze (1999)] was that the impact of technological progress was such as to mandate a wage change that were exceeded by actual wage changes, with the implication that employment should have fallen. The impact of technological change similarly was on mandated factor earnings. Since in the present estimation we control explicitly for the impact of the marginal cost of capital, this effect may be diluted.

that it adds little information over and above the change in capacity utilisation. Since openness can also be seen as an indicator of demand for output, inclusion of both variables does not serve to add much additional information. Nevertheless the finding confirms that exposure of manufacturing sectors to international output markets does not appear to lower investment rates.

The last insignificant additional variable is the log change of real labour remuneration. While there are some a priori grounds for supposing that it is relative factor prices that might drive the investment rate in fixed capital, we find that only the real user cost exerts an influence on investment rates, while the real cost of the potential substitute factor of production proves to be statistically insignificant[50]. The implication thus is that an increasing real cost of labour does not increase capital intensity of production in the manufacturing sector, although it may decrease the usage of labour in manufacturing industry[51].

The positive and significant impact of changes in the rate of return on capital conforms to prior expectations. Increasing return on capital generates higher rates of investment. The implication here is that the capacity utilisation variable alone does not suffice in capturing the expected rate of return on capital stock for the South African manufacturing sector. Thus the change in the rate of return on capital appears to add information over and above that already contained in the proxy employed for $d \ln Y_t^e$ . The negative and significant coefficient on the skills ratio implies that skilled labour and capital are to some extent substitutes in South African manufacturing industry. Greater access to skilled labour has allowed manufacturing sectors to lower their investment in capital stock. One interpretation of this evidence is that the long history of South African underinvestment in human capital has served to stimulate investment in capital equipment in order to raise productivity levels of labour poorly endowed with human capital[52]. This may have been one means by which manufacturing industry could hope to remain competitive in the face of global market conditions. Thus the poorly conceived educational policies of past South African governments may have served to generate the additional negative consequence of generating a reliance on increased capital intensity of production.

Finally, we observe that the estimation incorporating government investment expenditure does find some evidence in favour of crowding-in effects. The coefficient on the variable is both significant and of positive sign. Two considerations should cause the reader to exercise caution in interpreting this result, however. First, the crowding-in effect proves to be small[53], and second the specification is no longer strictly comparable to others for which we report results. In particular, we were not able to control for both uncertainty and government investment expenditure[54]. Moreover, full evaluation of the crowding in would have to consider the cost of the government investment expenditure, and whether the net gain to society was positive or negative. Nevertheless, the coefficient does point toward the possibility of some effect having been present on manufacturing investment.

[50] This conforms to the suggestion in Fedderke, Shin & Vaze (1999), that the two factors appear to be complements rather than substitutes over the sample period.
[51] See again Fedderke, Shin & Vaze (1999) on this finding
[52] See the more detailed exposition in Fedderke, De Kadt & Luiz (2000a, 2000b), and Fedderke & Luiz (1999).
[53] This follows since a 1% increase in government investment generates only a 0.04 percentage point increase in private sector investment, while simultaneously carrying crowding out potential through the impact of government borrowing requirements on interest rates.

***5.5) Conclusions***

Estimation results of this study carry a number of core conclusions. First, we find that the base Jorgenson or neoclassical model does not find strong support from the empirical evidence afforded by the South African manufacturing industry. Second, uncertainty appears to impact on investment rates in the manufacturing sector. In particular, systemic uncertainty (as proxied by an index of political instability) lowers investment rates in manufacturing industry. This result is a consistent and robust finding regardless of which other variables are controlled for in estimation. The international evidence on the impact of uncertainty on investment thus finds corroboration in the instance of a middle income country. The uncertainty findings carry with them immediate policy implications. Stability at a systemic level appears crucial if investment rates in South African manufacturing industry are to rise. This carries implications both for the conduct of macroeconomic policy and the need for an emphasis on stability in its conduct, but also for the importance of creating a stable political environment able to pursue credible policy orientations over time. By the latter we refer to the importance of creating a policy environment that renders the policy making process predictable, rather than subject to problems of time inconsistency. Past political dispensations in South Africa with their associated large discretionary power vested in the state, rendered the prospect of arbitrary state intervention ever real. The move to a liberal democratic polity has lowered this source of uncertainty, and we have seen sound economic reasons for guarding this political advance.

Third, the real user cost of capital was found to be statistically significant as a determinant of investment rates in South African manufacturing industry. The implication of this is twofold. In the first instance the impact of factors that change the user cost of investment such as high taxation rates for instance act as a deterrent to investment[55]. The corollary is that policy makers play a role in creating the appropriate conditions for rising investment rates through an alteration of the real user cost of capital. But equally, the real user cost of capital is only one of a umber of determinants of investment. This implies that for policy makers a simple focus on the user cost of capital is not enough. Instead it is imperative that policy makers create the conditions of long term macroeconomic stability, and of sufficient rates of return on investment (see the positive and significant coefficient on the change capacity utilisation variable, as well as the rate of return on capital stock variable) that create a climate conducive to high investment rates.

Thus far the core findings. But we found also that credit rationing appears not to have played a role in the formal manufacturing sectors it may of course be a significant factor in the informal sector not included in the sample on which our data is based and technological change, openness, and changes in the real cost of labour are similarly insignificant as determinants of investment rates. We suggested that the finding on the negative impact of the skills ratio in the employment of manufacturing sectors is consistent with the suggestion that the poorly conceived educational policies of past South African governments may have served to generate the additional negative consequence of generating a reliance on increased capital intensity of production. The rate of return on capital stock appears to add information on the expected payoff to investment expenditure over and above the capacity utilisation proxy employed throughout the present study.

[54] Software limitations prevent the inclusion of more than one reference variable.
[55] In effect the implication is that a "Keynesian" view of investment that discounts the importance of user cost of capital as a determinant of investment rates finds little credence on the basis of the presented evidence.

***Appendix 5A: Panel estimation techniques***

This appendix will briefly review the panel estimation techniques used in the report. For more detail see Fedderke (2000).

*Fixed effect modelling of a panel*

The fixed effect models of this phenomenon capture the panel nature the disturbance term. The most common means to model the disturbance term is a one-way error component which suggests that the unexplained factors can be separated into a time-invariant component and a portion which varies for each observation both in time and across groups. The time-invariant component captures unobservable group-specific effects. By introducing some assumptions about the nature of the distribution of the disturbance terms, such as that they are normally distributed with zero mean, a likelihood function can be derived and this is then maximised to give parameter estimates. This is a relatively simple treatment of the panel properties, modelling little variation across groups. The fixed effect estimates model all group variation in terms of different intercepts (a common improvement on this limitation is to allow cross-sector variation in slope coefficients).

*Dynamic fixed effect modelling of a panel*

Economic relationships modelled by panel are often dynamic in nature. Time-series methods can be used to analyse the dynamics of adjustment. This is most commonly done by introducing a lag structure to the estimated model both in terms of the explanatory and the dependent variables. This technique has been used by a number of analysts in panels. Essentially, the above model is re-written as an ARDL which nests a long-run relationship between dependent and independent variables. The long-run parameters can readily be identified by modelling the system when it is stable. The disturbance can be modelled as with the fixed effects model in that there would be two error terms: one group specific, the other different for each observation. Given that the disturbance terms follow a normal distribution with zero mean, the likelihood function can be derived and maximisation will yield parameter estimates. Again, the treatment is quite simple, modelling variation across the panel only in terms of its effect on the mean value and not on slope coefficients. However, the introduction of a lag structure allows the speed of adjustment to be quantified giving an insight into the dynamics within the data.

*The pooled mean group estimator*

Pesaran (1997:433) extends the dynamic fixed effects estimation model to analyse a dynamic panel where the time-series observation for a given category is pooled with the other observations. This is achieved in two stages. Firstly, the disturbance term is modelled allowing for the possibility of some correlation between the errors across a category in the panel. The ARDL representation however is modified to allow heterogeneity in the dynamics of the model. In other words, the dynamics are allowed to vary across the groups. Moreover, the short-run variation of the data is modelled separately in each group through an error correction process. Given the above mentioned assumptions about the disturbance term, again a likelihood function can be derived which can be maximised to give parameter estimates. The PMG estimator offers an intermediate case between the dynamic fixed effect panel estimator and the mean group estimator, discussed below, in that it allows the

intercepts, short-run coefficients and error variance to differ freely across groups, but the long-run coefficients are constrained to be homogeneous across groups.

*Mean group estimation*

A means to allow for the maximum degree of heterogeneity across a panel is to treat each group separately and to estimate separate dynamic relationships for the time-series data of each group. The long-run equilibrium relationship and the short-run dynamics can then be derived for each group. A powerful statistical finding is Pesaran and Smith's (1995) demonstration that the average of the estimated parameters is an unbiased estimate of the average long-run relationship. Other estimates, such as aggregating the group data and then estimating a single time-series model, will give biased results unless the long-run equilibrium relationship is homogenous across the panel. This averaging of group estimates is the basis for the mean group estimators (MGE, see Pesaran and Smith, 1995). The analysis provides the distribution of the mean group estimates and this can be used to test whether this model, which imposes very little structure on the process, better explains the data relative to other estimation models.

The effect of both long-run and short-run heterogeneity on the means of the coefficient is determined by the Hausman test applied to the difference between MG and PMG or DFE estimators. In this report we will examine the extent of panel heterogeneity mainly in terms of difference between MG and PMG estimates of long-run coefficients using the Hausman test. A significant test result may suggest that we adopt a more pragmatic approach in that we divide the total group of samples into sub-group samples, which may differ in the nature and strength of the relationship being estimated. Then, each sub-group's behaviour can be compared with theoretical expectations , and therefore we would draw qualitatively different results for heterogeneous sub-groups. In the study, however, we will generally only report the results of estimations across the full sample - except where otherwise indicated.

*Estimation procedure*

Estimation proceeds by using maximum likelihood techniques given that the error terms are independently distributed with zero means. The Newton-Raphson method of maximisation can be used for this. Alternatively, parameter estimates can be derived through a back-substitution algorithm. The former method requires estimation of the first and second derivative of the likelihood function while the latter requires only the first derivative. Estimation of standard errors is more complicated as allowance has to be made for non-stationary regressors. Pesaran (1997:433) explores this aspect and derives the asymptotic distribution of the PMG parameter estimates. Gauss code is available on the web to produce the parameter estimates and calculate asymptotic standard errors. Such code is used in the present estimations.

*The data*

The data set used in this section is composed of a panel of the 28 three-digit SIC version 5 manufacturing sectors in the South African economy observed annually over the period 1970-97. Focussing on the manufacturing sector rather than the whole industry sectors (46 three-digit SIC version 5 sectors) is mainly for the following reason. The target group of TIPS is predominantly interested in manufacturing. An exception is

the services sector, but investment expenditure in machinery is probably relatively less relevant to its growth performance. Moreover, with respect to the capacity utilisation variable, data is available only for the manufacturing sectors. Both $T = 28$ and $N = 28$ are sufficiently large, which allows the use of dynamic panel techniques to estimate a long-run equilibrium relationship while at the same time modelling the short-run dynamics.

***Appendix 5B: The Reasons for not Placing Greater Emphasis on Individual Sectoral Results:***

It may appear as if one attraction presented by the panel estimation methodology employed in the present report is that individual sectoral results can be lifted directly from the Mean Group estimator. For instance, the evidence presented in Table 5.4 presents estimated coefficients in all of the dimensions of the most basic formulation of the irreversibility approach to investment: expected output (rate of return on capital), the real user cost of capital, and uncertainty. Similar results are available (on request) for any of the specifications examined in the study.

The question now is why we cannot use the coefficients so estimated directly as a means of obtaining information about individual sectors, and then formulating policy in accordance with these findings?

The answer to this lies in a number of considerations:

1) One is to take a closer look at the details of the estimation results reported in Table 5.4. Consider for instance the coefficients on the expected output (*dutil*) and the user cost of capital variables (*duc*). A brief consideration of the sectoral results quickly establishes that a number of sectors have theoretically questionable signs on both variables. For instance, the Beverages and Textiles sectors (amongst others) have a negative sign on the *dutil* variable, while the Tobacco and Paper sectors (again amongst others) have a positive sign on the *duc* variable.

   The technical reason for this is that the results of Table 5.4 rest on the Mean Group estimator, which estimates the investment function for each sector separately. Such estimation has low power in the current context, because of the small number of observations available for each sector. This is explained in greater detail in point 2 below.

   But intuitively, it is not difficult to explain the problem here. Approaching each sector individually is feasible only where we have large amounts of information available for each sector over protracted periods of time. For South African manufacturing this is simply not the case – our data extends only over the 1970-97 period, giving us 27 annual observations for each sector. Such a data source is too meagre to be able to obtain accurate information on the characteristics of each sector. We struggle to separate noise from signal by means of the standard estimation techniques that would be appropriate to an investigation of each sector individually.

This point poses two questions. First, why precisely are the estimation techniques relevant to individual sector results inappropriate in the presence of small samples? We deal with this question in the following point. Second, why can we attach confidence to the results presented in the present study, and how do they justify the claim that they do take into account heterogeneity between sectors? The third point below addresses these concerns.

2) Where the interest lies in the characteristics of an individual sector, the appropriate methodology would be time series analysis, and cointegration estimation in particular. In fact, the estimation technique employed in the current context is a single equation cointegration estimation technique, the ARDL approach. The advantage of the approach over other single equation techniques is that it estimates long run equilibrium, the characteristics of adjustment to equilibrium and short run dynamics simultaneously, thereby rendering the estimation efficient. But at the very least if an accurate understanding of individual sector characteristics is to be obtained, what is required is a consideration of the number of vectors spanning the cointegrating space, and where appropriate that the necessary just identifying restrictions be imposed.

What this means is that the identification of legitimate single sector results requires:

a) the close examination of the residual's structure required by cointegration analysis,
b) the separation of the long run equilibrium relationship that is of interest, from other equilibrium relationships that may exist between the variables included in the analysis, as well as (possibly) meaningless linear combinations of variables that have stationary residuals

So if this is the means by which single sector results ought to be obtained, what is stopping us?
The answer lies in the data. Cointegration analysis unfortunately is very data hungry. This can be understood from the fact that each equation being estimated contains not only the long run equilibrium relationship being estimated, but also information about the dynamics governing the evolution of the outcome variable. For instance, even in the relatively parsimonious specification underlying the results reported in Table 5.4, we have four variables included in the specification of long run equilibrium. In addition, since we are employing an ARDL of lag length 2, each of the variables included in long run equilibrium would appear twice in first difference format in the dynamics of the process governing changes in the outcome variable, giving an additional 4x2=8 variables. Thus loss of degrees of freedom mounts rapidly. Where there is more than one cointegrating (long run) relationship present in the data, each of the long run relationships absorbs a symmetrical number of degrees of freedom, thus compounding the data hunger of the estimation technique.

On the South African manufacturing sectors we have 27 observations per sector. It follows that even the most simple of specifications (such as that reported in Table 5.4 ) would very quickly generate very low power (which means that we face a very high probability of accepting the hypothesis being tested, when in fact the hypothesis is false) on the estimation results. Where more than one equilibrium relationship is present, we may simply not have enough observations to be able to estimate.

We have no recourse but to use another approach. But the question must then be why we use the dynamic heterogeneous panel estimation approach deployed in the present study. Does it solve the problems that attach to sectoral specific cointegration analysis?

3) Fortunately the answer is: yes. The preference for the Pooled Mean Group (PMG) estimator rests precisely on the insight that the power of our statistical techniques to estimate long run relationships for each sector included in a panel data set is limited. Instead we allow the long run relationship across sectors to be homogeneous, and instead allow heterogeneity to invest in the dynamics driving the outcome variable. This serves a number of useful functions
   a) We can allow for heterogeneity between sectors – the dynamics allow for strong differences between sectors.
   b) We obtain considerable statistical power in estimating the long run equilibrium relationship. For instance, in the present application, since we have 28 groups each with 27 observations, we have 756 observations providing information on the long run investment relationship that holds for the manufacturing sector (compare this with the 27 observations we have for each sector). This considerable quantity of information explains why the estimation results are so robust: the quantity of information is such that estimation is rarely fooled into making errors.

Of course, we may wish to argue that there is heterogeneity in the long run equilibrium relationship being estimated. But the PMG estimator allows us to address this problem. The way to proceed is to undertake PMG estimations on groupings of sectors that are deemed homogeneous on a priori grounds – as long as one bears in mind that the problem of low power constantly lurks. The latter point means that we have to ensure that the groupings of sectors are large enough (have enough observations) to generate sufficient power such that estimation results are rendered reliable. For instance, in the detailed study we undertook a separation of the manufacturing sector into the Wage Goods, Resource Intensive Goods, and Fabricated Goods sectors, in order to compare the coefficients that emerge for investment functions estimated for each group separately. As we reported, evidence of heterogeneity did emerge from the results: the groupings differed in a number of dimensions, and policy results do flow from such differences. In short, the PMG estimator represents a useful compromise: able to deal with heterogeneity while maintaining the power in estimation that is the point of panel data analysis. It is these considerations that governed our choice of estimation technique.

# Section 6: Some Notes on Foreign Direct Investment in South Africa

### *6.1) Introduction*

The literature has produced lengthy deliberations on the role of FDI in economic growth and the objective of this section is not to review these debates. Instead, we will try to develop some linkages between the determinants of domestic fixed investment and foreign direct investment in South Africa. This section is by no means comprehensive and it is merely intended to complement, to a limited degree, the analysis on domestic investment.

There are two specific issues of importance:

- To what extent does domestic investment behaviour differ from foreign behaviour
- How critical is foreign investment for South Africa

In terms of the first issue, section 2 had noted that foreign firms

- face larger information asymmetries about the host countries than domestic firms.
- may have higher expected profitability in the home country or in a competitive destination other than South Africa.
- are more sensitive to foreign exchange regulation
- are reliant on domestic investment behaviour.

These issues are difficult to separate in the absence of systematic data. Data limitations preclude a detailed discussion of FDI, specifically using time-series analysis that is analogous to our treatment of sectoral domestic investment. Indeed, a more comprehensive study of how investment decisions are being made by foreign firm is in progress in a parallel project funded by the EU.

### *6.2) Trends in FDI for South Africa*

The importance of FDI is often exaggerated in South Africa. With a developed private sector, and high corporate savings rate, the key issue in South Africa is not whether we can increase FDI, but whether we can increase investment as a whole. As we can see in the Table 6.1, the major source of investment in South Africa is the domestic capital market. This does not deny that there is an important qualitative impact specifically technology transfer implications, however, a discussion of this issue is beyond our scope. The table below presents data on FDI in the context of domestic investment.

Table 6.1: Foreign Direct Investment Inflows in relation to Gross Domestic Investment and Gross Domestic Product

| Years | FDI (% of GDI) | FDI (% of GDP) |
|---|---|---|
| 1994 | 1.6 | 0.3 |
| 1995 | 3.9 | 0.7 |
| 1996 | 3.5 | 0.6 |
| 1997 | 8.4 | 1.3 |

*Data source: World Development Indicator, 1999,*

Although FDI as a percentage of Gross Domestic Investment (GDI) has increased dramatically from 1994 to 1997 it remains small. The relatively high growth rate of 8.4% in the last year of the period of observation is therefore mainly due to a low base. But, as we will show later on, this growth is not necessarily in new investment. FDI as a percentage of GDP has increased from 0.3% in 1994 to 0.7% 1995, followed by a slight decrease to 0.6% in 1996 and a sharp increase in 1997 (1.3%). This trend is in line with data from BusinessMap shown below.

Another look at trends in FDI in SA is presented in Tables 6.2 and 6.3. Table 6.2 shows data from the IMF and in Table 6.3 we present information from BusinessMap. It can easily be seen that data from the two sources is not consistent. Table 6.2 shows an upward trend in FDI to South Africa from 1992 to 1995 and a decline in 1996 from R42.6 billion to R23.5 billion. The subsequent increase in 1997 was not as tremendous as the decrease in 1996 with an expansion from R 23.5 billion to R 28.8 billion.

Table 6.2: Foreign-Direct Investment in South Africa according to changes in foreign liabilities of South Africa

| Years | R billion | Annual Growth |
|---|---|---|
| 1991 | 24.7 | |
| 1992 | 26.7 | 1.7 |
| 1993 | 29.2 | 2.5 |
| 1994 | 36.0 | 6.8 |
| 1995 | 42.6 | 6.6 |
| 1996 | 23.5 | -19.1 |
| 1997 | 28.8 | 5.3 |

*Source: IMF*

In Table 6.3 it can be seen that, according to BusinessMap, FDI has steadily increased over the past five years despite the slow down between 1994 and 1995 from 6.1 billion to 5.7 billion. From 1995 there was an acceleration in FDI inflow from R 5.7 billion in 1996 and almost a doubling in 1997 to R 15.7 billion.

Table 6.3: FDI inflows South Africa

| Year | R m | % change | US$ | % change |
|---|---|---|---|---|
| 1994 | 6,101 | | 1,723 | |
| 1995 | 5,712 | -6.4 | 1,574 | -8.7 |
| 1996 | 8,711 | 52.5 | 2,026 | 28.7 |
| 1997 | 15,721 | 80.5 | 3,418 | 68.7 |
| 1998 | 17,949 | 14.2 | 3,252 | -4.9 |
| 1999 | 24,292 | 35.3 | 3.989 | 22.7 |
| Average | | 35.2 | | 21.3 |

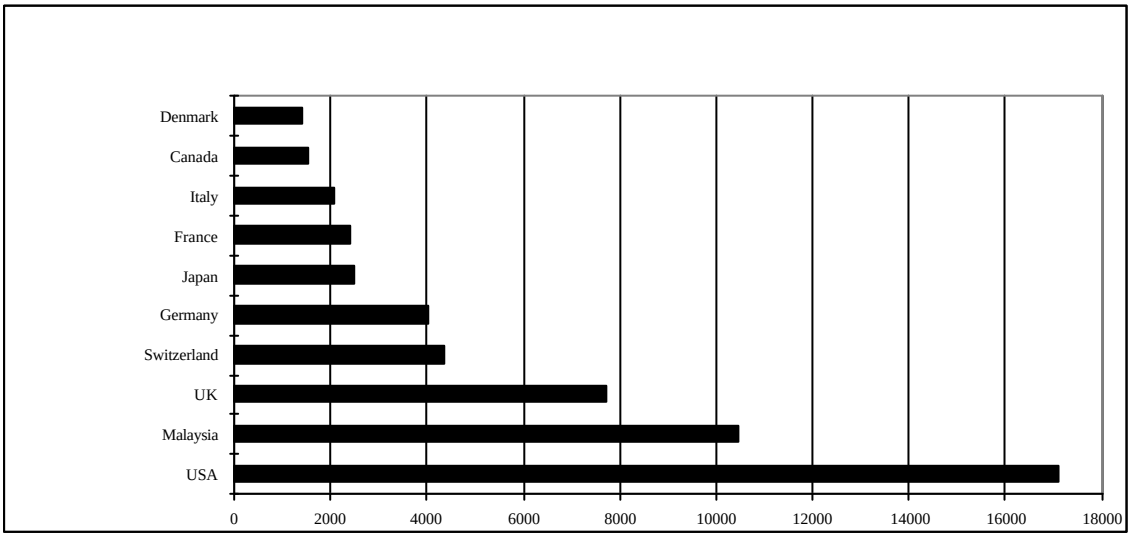
*Source: Heese (1999)*

Table 6.3 presents the average annual growth in FDI from the BusinessMap source, which is fairly high on the basis of nominal Rand value at 35.2% and at 21.3% on the basis of nominal US dollar values. A discussion of the reason for the differences between Tables 6.2 and 6.3 is offered below

***6.3) Sources of Foreign Direct Investment in South Africa.***

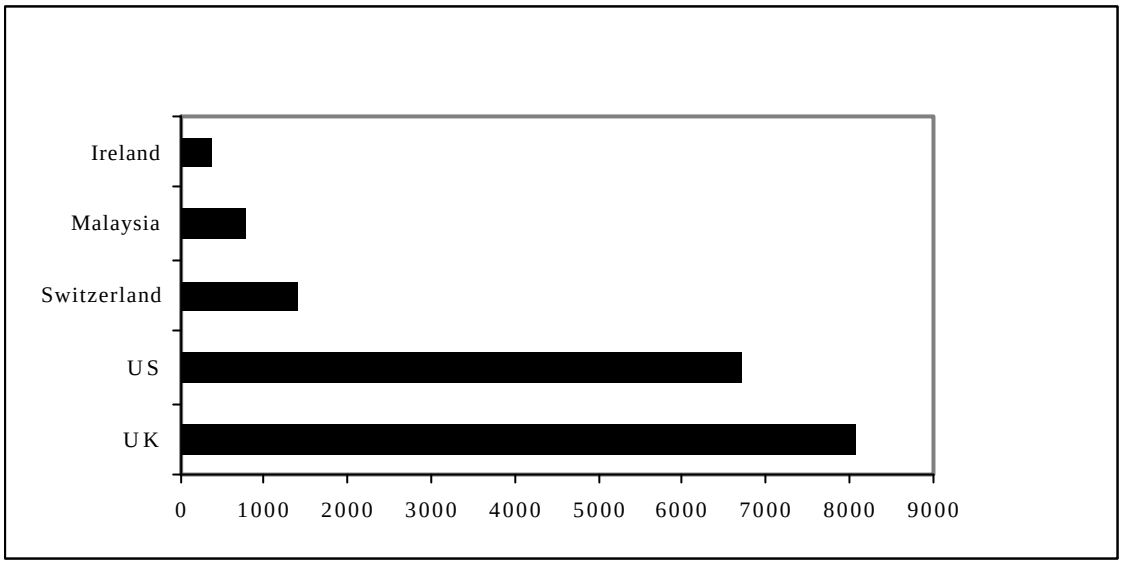
It is difficult to do an analysis of the specific configuration of countries that are investing in South Africa. Ideally it would have been useful to look at changing patterns of investor countries in South Africa and whether the changes in the South African economy and political landscape could be associated with more diversified investors. BusinessMap's data tracks investment in the 1990s and some tentative conclusions can be made. As we can see below, the composition of countries varies from year to year. This suggests that the profile FDI by country of source very much depends on the specific investment deal at hand.

Figure 6.1: FDI in South Africa by Country of Source, 1998 R millions




*Source: Heese (1999)*

Figure 6.2: FDI in South Africa by Country of Source, 1999 R millions




*Source: Heese (1999)*

The US and UK continue to be South Africa's largest foreign investors followed by Malaysia's, Germany and Japan. Other traditional large investors are Sweden, France, Switzerland, Australia and South Korea.
What is more interesting is the emergence of some new investors. For example, Ireland surfaced as an important new investor, taking up shares in the food and beverage sector (Heese, 1999). Other up-and-coming investors are Kuwait, Indonesia, India, United Arab Emirates (Dubai), Singapore and Thailand, where some promising relationships appear to developed.

Table 6.4: Investment deals by country

| Country | Count (1994-99) |
|---|---|
| USA | 88 |
| UK | 64 |
| Malaysia | 31 |
| Germany | 21 |
| Japan | 17 |
| Sweden | 15 |
| France | 12 |
| Switzerland | 11 |
| Australia | 10 |
| South Korea | 10 |
| Multinational | 9 |
| Netherlands | 9 |
| Italy | 8 |
| Canada | 7 |
| Norway | 6 |
| Kuwait | 5 |
| Indonesia | 4 |
| Austria | 3 |
| Belgium | 3 |
| India | 3 |
| China | 2 |
| Denmark | 2 |
| Ireland | 2 |

*Source: Heese (1999)*

The increasing potential for diversified sources for FDI could be an added boost to the relatively increasing importance of FDI in South Africa. But as for the pre-election period, Europe and the US remain the major investors.

A detailed analysis of why particular investors choose South Africa is not possible but it is an important issue not only to ascertain if there is any difference between foreign and domestic behaviour but also to assess whether there is a difference amongst countries. For example, Malaysian investment may be related specifically to cultural links with South Africa and that Malaysians have a capacity in services. The question then needs to be posed whether services are more attractive to foreign investment than manufacturing.

***6.4) Sector profile***

An analysis of FDI could be more revealing if data is available which is comparable to that of domestic investment presented in the previous sections. Such data would allow an evaluation of potential systematic differences in investment patterns at the sectoral level However, such a comparison is not easily possible over a consistent period of time. Even where data is available for one or two years it is difficult to compare sectoral foreign investment patterns with domestic investment, partly because of the way FDI is recorded. This is illustrated in the next table and figure.

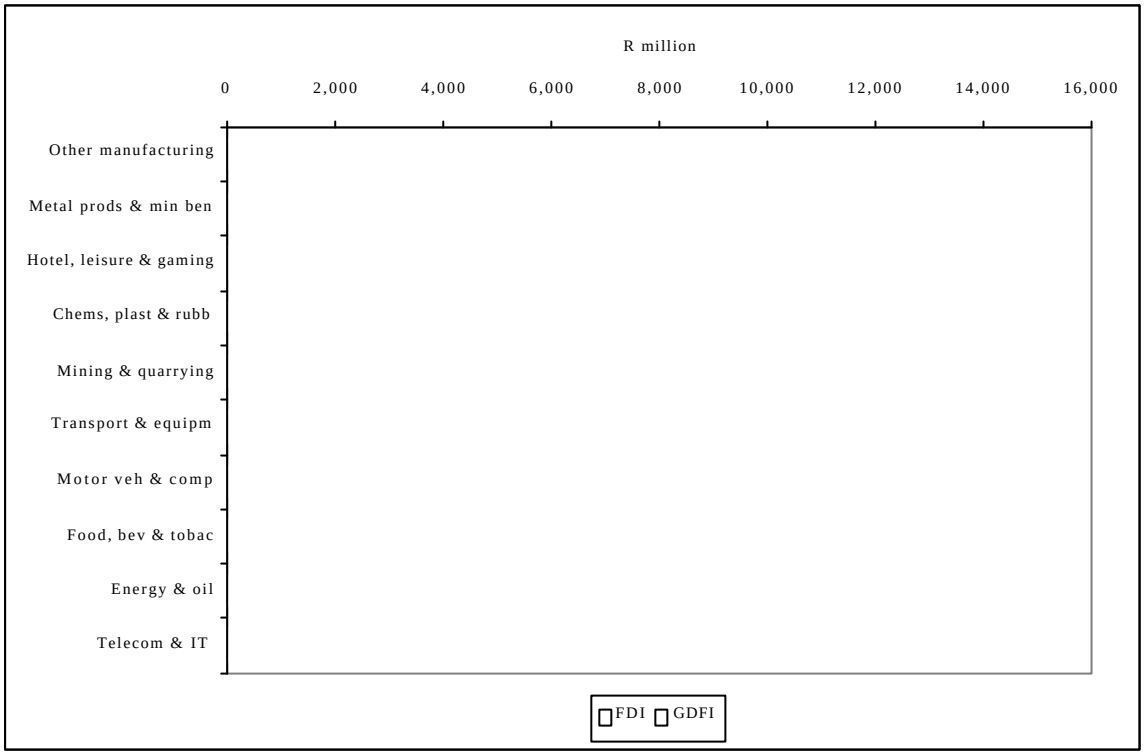
Table 6.5: Sectoral FDI Compared to GDFI (1998, R million current prices)

| | FDI | GDFI | FDI / GDFI | GDFI sector description |
|---|---|---|---|---|
| Other Manufacturing | 2,608 | 949 | 274.8% | Machinery; Electrical machinery; TV, radio etc; Professional & scientific equipment |
| Metal Prods & Min Ben | 2,704 | 8,489 | 31.9% | Basic iron & steel, Non-ferrous metals & Metal products |
| Hotel, Leisure & Gaming | 2,936 | 6,984 | 42.0% | Catering & accommodation |
| Chems, Plast & Rubber | 3,498 | 4,470 | 78.2% | Basic & other chemicals; rubber & plastic products |
| Mining & Quarrying | 3,959 | 11,776 | 33.6% | Coal mining, gold mining & other mining |
| Transport & Equipm | 4,539 | 15,015 | 30.2% | Investment in transport equipment by transport and communication sector and total investment by the transport equipment sector |
| Motor Veh & Comp | 5,536 | 1,938 | 285.7% | Motor vehicles and components |
| Food, Bev & Tobac | 5,642 | 4,793 | 117.7% | Foods, beverages and tobacco |
| Energy & Oil | 8,517 | 8,850 | 96.2% | Coke and petroleum refineries, Electricity and water supply |
| Telecom & IT | 8,768 | 9,561 | 91.7% | Total investment by the transport & communication sector less investment in transport equipment |
| | 48,706 | 73,991 | 65.8% | |

*Sources: FDI: Heese (1999), GDFI: WEFA*

Note that we had to be rather arbitrary in terms of the choice of sectors in order to compile sectoral GDFI values comparable to the BusinessMap records.

Figure 6.3: Sectoral FDI Compared to GDFI



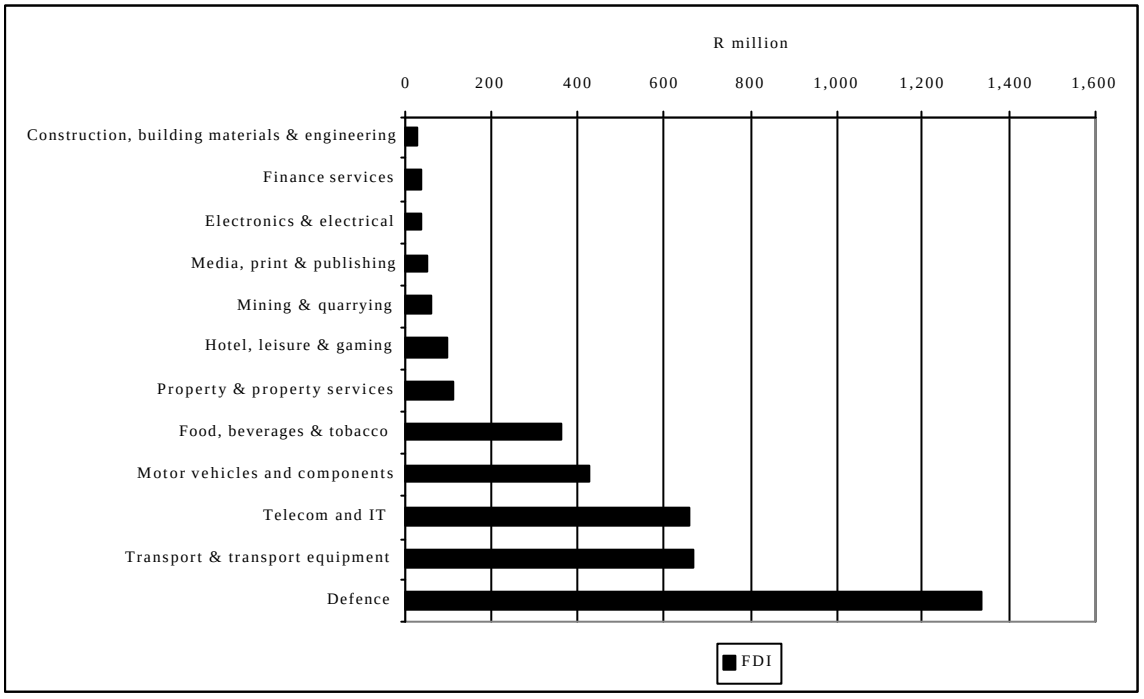

*Sources: FDI: Heese (1999), GDFI: WEFA*

It would appear that the two data series are not compatible. For some sectors (other manufacturing, food, beverages and tobacco, mo tor vehicles and components) FDI, as recorded by BusinessMap, is larger than GDFI. While the latter is consistent with the SARB national accounts notion of capital expenditure in fixed assets, BusinessMap data (and other FDI data shown above), even though it is direct as opposed to indirect, in general could include investment in existing assets, which then merely is a change in asset ownership. In addition, BusinessMap includes investment that is on the cards but may only show up as GDFI at a later stage, spread over a number of years. This will be discussed further below.

Notwithstanding these problems, some observations can be made from foreign investment behaviour in South Africa. Most FDI recently has taken place in services and there may be specific reasons for this. The first is that manufacturing FDI may not be as attractive as services. Secondly, investment is driven by deregulation and privatisation efforts. The composition of FDI in specific sectors changes from year to year. For example, defence does not feature at all in 1998 but is the highest in 1999.

According to BusinessMap a top FDI sector continues to be IT/Telecom attributable to a number of investments in the local monopoly, Telkom, while Energy and oil have become more significant. There is some foreign investment in Agro-Processing and Manufacturing. – these are Food, Beverages & Tobacco, Motor vehicles & Components and Chemicals, Plastics & Rubber products. Mining & Quarrying is also receiving new attention with investments by Lonhro and Placer Dome in 1998. Transport has emerged as an important sector in 1999 with the privatisation of SAA and the sale of Safren's assets. FDI in Hotels, Leisure & Gaming has dropped off since a peak in the mid 1990s (Heese, 1999).

Figure 6.4: Top ten FDI Sectors, 1999




*Source: Heese (1999)*

Top FDI sectors for 1999 were defence - accounted for by the Denel deal (part of the counter trade arrangements arising from the defence procurement package), food beverages and tobacco, and mining (building on South African resource-based comparative advantages), transport and transport equipment - influenced by the restructuring of Safmarine, on-going interest in financial services (although investments tend to relatively smaller in monetary terms than in other sectors, they are often significant as facilitators for further investment), sustained interest in a number of motor component ventures, and IT (mainly influenced by the Thawte acquisition in the IT industry, Heese, 1999).

As mentioned earlier, sectors such as defence and financial services that did not even feature in the top 10 in the pervious year are sectors that are fairly prominent in 1999. This is largely attributable to the prominence of a specific investment deal, (see below for a discussion).

An analysis of the economic impact of different kinds of investment is beyond our scope here but it is important to note that a large percentage of South Africa's investments are in acquisitions and equity deals. BusinessMaps

figures show that some 60% of FDI in South Africa that took place was in the form of acquisitions for the period 1994 to 1999.

Table 6.6: Distribution of investment by type (when first recorded 1994-99)

| Description | Proportion |
|---|---|
| Mergers & Acquisitions | 60.4 |
| Expansion | 17.3 |
| New | 16.7 |
| Investment* | 4.5 |
| Intention | 3.1 |
| Liquidation | -0.6 |
| Disinvestment | -1.5 |

*Source: BusinessMap, Note*: Change of foreign holding from indirect to direct, which could end up being any of the other types*

What is striking about current FDI is that it is very specific to regulatory changes in certain sectors and is primarily focused on equity stakes. From Table 6.6 it appears that FDI has not contributed as much to the expansion of productive capacity in the South African economy as has been suggested, greenfield operations have remained limited to date.

Finally we present BusinessMap information on some of the major investment deals. The actual values of these individual deals were calculated against the total FDI values. These still constitute a small percentage of total investment, but significant in some sectors.

Table 6.7: Top FDI deals

| Investment | Investor | Country | Sector | Rm | % of total | Year |
|---|---|---|---|---|---|---|
| Telkom | SBC Communication/Telkom Malaysia | USA/Malaysia | Telecom and IT | 5520 | 7.3% | 1997 |
| Engen | Petronas | Malaysia | Energy and Oil | 4000 | 22.3% | 1998 |
| Sentrachem | Dow Chemicals | USA | Chemicals, Plastics and Rubber Prods | 2320 | 14.8% | 1997 |
| Engen | Petronas | Malaysia | Energy and Oil | 1900 | 21.8% | 1996 |
| Blue Circle Cement | Lafarge – France | France | Construct, Building Mat & Engineering | 1530 | 8.5% | 1998 |
| SA Bottling Co | Coca Cola | USA | Food, Beverages and Tobacco | 1440 | 25.2% | 1995 |
| Western Areas LTD | Placer Dome Inc | Canada | Mining and Quarrying | 1410 | 7.9% | 1998 |
| SAA | Swissair | Switzerland | Transport and Transport Equipment | 1400 | 5.8% | 1999 |
| Tavistock Collieries | Lonrho Plc | UK | Mining and Quarrying | 1400 | 7.8% | 1998 |
| Safmarine | A P Moller | Denmark | Transport and Transport Equipment | 1222 | 5.0% | 1999 |

*Source: Heese (1999)*

### *6.5) Policy implications*

The major determinants of investment in the 1990s have essentially been the privatisation and restructuring of state assets. For example, BusinessMap shows that the privatisation of Eskom was the main contributor to the increase in 1997, with strictly private sector investment dropping slightly –almost 9 billions in 1996 compared to just over 8 billion in 1997. Foreign investors are drawn in by the restructuring of state assets - notably, SAA and Transnet - as well as greater economic activity and growth within the domestic economy. Government policies on privatisation and stimulating growth are therefore of key significance in boosting FDI prospects.

Owing to the paucity of data it is difficult to tell over a sustained period of time whether the sectoral distribution of FDI is fundamentally different from the allocation of domestic capital stock in the economy. A great deal of effort has to be put in tracking data on FDI over a consistent time period.

The major finding of this section is that it is not possible to provide as rigorous a study of FDI as we have done with gross domestic fixed investment. Indeed, the challenge is to put pressure on data generators such Stats SA to collect data in a way that would allow a more substantive analysis of FDI.

One of the major data problems, specifically when differentiating FDI from foreign investment is that
FDI is often not real investment – frequently FDI takes the form of mergers and acquisitions that represent transfers of ownership of existing assets from domestic to foreign firms.

# Section 7: Conclusions

Low investment levels in the South African economy are consistently identified as the principal factor behind the suboptimal growth rates. Despite the increasing recognition of the importance of investment there is alarmingly little analytical research available in South Africa on the determinants of investment behaviour, specifically at the sectoral level. The aim of the report was to make a contribution to the understanding of sectoral trends in investment in South Africa by using recently compiled economy-wide data that covers the period of 1970-1997 for a range of economic variables and a number of production activities. It should be emphasised that the report offers a top down overview of sectoral investment behaviour in South Africa and complements more sector specific studies that employ survey techniques. However use of new panel data estimation techniques gives us the opportunity to identify both the long run equilibrium relationships that hold between variables, as well as the nature of the dynamics that describe adjustment to equilibrium. We now can now repeat and summarise the main conclusions of the report.

There is a long history of the study of the determinants of investment behaviour and Section 2 reviewed some of the salient points from the literature. It was concluded that that ample work needs to be done in examining investment in South Africa so that investment behaviour in the country is better understood. Of primary importance, empirically based research should attempt to examine the variables that influence investment spending. Economic theory identifies these variables but empirical research can be used to determine the extent to which microeconomic and macroeconomic variables affect investment behaviour. In addition, variables overlooked in past studies in the South African literature such as uncertainty and instability should be included in any empirical research. This is particularly important given the current evidence that indicates these variables have a considerable influence on investment in the developing world, including South Africa. Furthermore, the section argued that studies should examine the influence of the financial sector variables on investment behaviour with a particular interest on determining if South African firms are financially constrained. Once the variables that impact investment behaviour are determined one can attempt to ascertain how the government can best influence these variables, if at all. Given that government policy can positively influence variables, an attractive investment climate can be pursued more effectively. By undertaking such research, public policy intended to encourage or attract investment in South Africa can be better designed and implemented. After the theoretical exposition and review of research on the determinants of investment in South Africa and a brief discussion of the data base, the report then turned to the empirical work presented in Sections 4 and 5.

In Section 4 it was argued that more than just a descriptive analysis is required in order to get a clear picture of the determinants of investment in South Africa. While the exploratory data analysis did not provide a final and definitive assessment of the determinants of investment rates, this is not the purpose of descriptive data analysis. Rather, descriptive data analysis is a necessary step towards more detailed analysis in order to check for

consistencies in the data series and possible outliers. Nevertheless, the results of the descriptive analysis showed up some interesting findings, some of which were expected and some not. These can be summarised as follows:

1. A narrow focus on total capital stock is potentially misleading. The descriptive and econometric analysis is therefore undertaken in terms of the asset type Machinery & Equipment.
2. Sectoral growth rates in capital stock of Machinery & Equipment suggest a bias in the South African capital markets due to the heavy reliance on the mining of primary commodities during earlier phases of development of the economy, and the presence of substantial government-led investment in capital stock of a number of core sectors (Electricity, Gas & Water; Petroleum Refining). The gradual reversal of these earlier trends appears to have triggered a restructuring of the South African capital market. In particular, sectors whose access to capital might have been limited due to the demand originating from resource based and state sectors during the earlier decades of our period of review, have shown strong growth in their capital stock.
3. The implication of such a line of reasoning (if correct), is that one explanation why investment expenditure in South Africa, both in absolute terms as well as relative to value added, is currently at such low levels is simply that strong growth rates in capital stock are being maintained in sectors with low absolute levels of capital stock. Such sectors may have been prevented from increasing their capital stock from past biases in the economy's capital markets.
4. The 1990's and its changed policy environment may have had an impact on capital usage in the South African economy. This is most evident in the declining Machinery & Equipment capital stock in Electricity, Gas & Water, and above all the strong increase in the usage of this category of capital by the Basic Iron & Steel and Diamond and Other Mining sectors. Given that the period after 1985 saw a sharp decrease in the value of the Rand without any recovery post-1990, the implication is that the increased exposure to capital in these sectors took place despite the increasing supply price of capital goods – and one plausible explanation may be the changes in the trade dispensation that occurred during the 1990's.
5. Some of the sectors with the highest growth in capital stock over the period 1970-1997 have experienced negative growth rates in real per labour remuneration and above average growth in labour productivity. The implication is that the real cost of labour is unlikely to have been the driving force for increased investment in capital for these sectors. The econometric analysis confirmed that the changes in the real cost of labour are insignificant as determinants of investment rates.
6. The possibility of a structural break in capital accumulation during the 1990's does not appear to be translating into a greater volatility of investment. For the economy as a whole the standard deviation of the growth rate of the real stock of Machinery & Equipment declines during the 1980's and the 1990's. Therefore, the structural break in investment behaviour, if present, has not manifested itself in greater volatility of investment – but rather in a different distribution of investment across sectors, and in a different level of investment expenditure in sectors.
7. Correlation coefficients between user costs of capital and capital usage (as embodied in the investment rate and growth in capital stock of Machinery & Equipment) suggests that over time, and for most sectors, the real user cost of capital seems to be at least one of the major determinants of investment expenditure in the South African economy. This observation is supported by the econometric analysis of section 5.

8. The user cost of capital appears to have formed a significant constraint on investment in real capital stock during the course of the 1970's, but the severity of this constraint declined during the course of the 1980's and 1990's. It could therefore be argued that the state in its effort to direct investment in South Africa may have raised the user cost of capital, and that the steady withdrawal of the state from the capital markets and increased reliance on market forces over time may have lowered such distortions. The disappearance of this negative association may be a reflection of the negative sentiment generated by the increased levels of political uncertainty that has characterised the 1980's, and the political transition of the 1990's. In other words, the importance of the real user costs of capital as an explanatory variable of investment behaviour may to some degree have been eroded by the political uncertainty factor.
9. The descriptive analysis of capital productivity, defined in the report as the ratio of value added and capital stock of Machinery & Equipment, suggests that while the 1970's and 1980's showed strong deviations in the distribution of capital across sectors in the economy, such that the productivity of capital was strongly differentiated across sectors, subsequent reallocation of capital stock in the economy appears to have equalised the productivity of capital across sectors. From a theoretical point we would anticipate that more perfect capital markets would serve to equalise the marginal product of capital across sectors, thereby generating more efficient allocation of capital stock.
10. Examination of correlations coefficients between real user costs of capital and various measures of capital stock growth suggest the presence of declining investment rates in sectors as they conform less closely to the dictates of standard economic theory. In other words, where the real user cost of capital is less closely linked to real capital productivity, the growth in capital also tends to be lower. For purposes of policy intervention in South African capital markets, "well-functioning" capital markets, are defined as those that more closely link factor rewards to factor productivity.
11. Evidence from the rate of return on capital variable, defined here as the ratio of gross operating surplus and capital stock is less conclusive. Any adequate explanation of investment in real capital stock will have to look beyond the real rate of return on capital stock, the correlation coefficient between the real rate of return and the growth rate in real capital stock across South African economic sectors shows wide divergence. The econometric analysis in section 5 suggested a statistically significant positive relationship.
12. In addition, we examined capacity utilisation as an explanatory variable for investment behaviour. Except for a few outliers, it seems that South Africa's basic industries, at the lower end of the "value chain" are running at relatively high levels of capacity utilisation, while further downstream, the opposite conclusion can be drawn. However, the correlation coefficients between capacity utilisation, as a proxy for demand, and the various measures of capital stock growth does not seem to give much support to the accelerator mechanism. The panel data analysis, however, suggested a positive relationship between capacity utilisation and investment, though there the variable was interpreted as a proxy for changing expectations of rates of return on capital.

Since we know investment expenditure to have a multivariate explanation, and ceteris is not paribus in the current context, the varied results of our descriptive analysis are perhaps not entirely surprising. Nevertheless, we believe that the exploratory analysis does lend credence to the presence of long run patterns of structural change in South African capital markets – played out over the full 1970-97 time frame. Moreover the 1990's

mark a second structural break, with the sudden emergence into prominence of (some) manufacturing sectors as leading investors, and the possibility that distortions to capital markets may have diminished over time, leading to a greater reliance on market forces.

Finally, Section 4 suggested that where economic sectors are allowed to respond to market forces, in the sense that factor rewards are more closely linked to factor productivity, investment rates are likely to be more sustainable in the long run. The evidence examined for this report, suggests that for South African capital markets the link between factor rewards and productivity appears to be have been strengthening during the course of the 1990's.

In the context of the descriptive analysis we have already hinted at some econometric results to which we now turn our attention. Using heterogeneous panel data techniques, the estimation results of section 5 point towards a number of core observations regarding investment behaviour in South Africa. First, we find that the results confirm a significant response of investment rates to changes in demand. Secondly, uncertainty appears to impact on investment rates in the manufacturing sector. In particular, systemic uncertainty (as proxied by an index of political instability) lowers investment rates in manufacturing industry. This result is a consistent and robust finding which is not sensitive to the introduction of labour unrest in the political instability index and regardless of which other variables are controlled for in estimation. The international evidence on the impact of uncertainty on investment thus finds corroboration in the instance of a middle income country such as South Africa. The uncertainty findings carry with them immediate policy implications. Stability, at a systemic level, appears crucial if investment rates in South African manufacturing industry are to rise. This bears implications both for the conduct of macroeconomic policy and the need for an emphasis on stability in its conduct, but also for the importance of creating a stable political environment able to pursue credible policy orientations over time. By the latter we refer to the importance of creating a policy environment that renders the policy making process predictable, rather than subject to problems of time inconsistency.

Third, the real user cost of capital was found to be statistically significant as a determinant of investment rates in South African manufacturing industry. The implication of this is twofold. In the first instance the impact of factors that change the user cost of investment such as high taxation rates for instance appear to act as a deterrent to investment. The corollary is that policy makers play a role in creating the appropriate conditions for rising investment rates through an alteration of the real user cost of capital. But equally, the real user cost of capital is only one of a number of determinants of investment. This implies that for policy makers a simple focus on the user cost of capital is not enough. Instead it is imperative that policy makers create the conditions of long term macroeconomic stability, and of sufficient rates of return on investment (see the positive and significant coefficient on the change capacity utilisation variable, as well as the rate of return on capital stock variable) that create a climate conducive to high investment rates.

Thus far the core findings. But we found also that credit rationing appears not to have played a role in the formal manufacturing sectors it may of course be a significant factor in the informal sector not included in the sample on which our data is based and technological change, openness, and changes in the real cost of labour are

similarly insignificant as determinants of investment rates. We suggested that the finding on the negative impact of the skills ratio in the employment of manufacturing sectors is consistent with the suggestion that the poorly conceived educational policies of past South African governments may have served to generate the additional negative consequence of generating a reliance on increased capital intensity of production. The rate of return on capital stock appears to add information on the expected payoff to investment expenditure over and above the capacity utilisation proxy employed throughout the present study.

Most econometric estimations are conducted at the aggregate level for manufacturing as a whole, in order to maximise statistical power. At the level of the individual manufacturing sectors there are simply not sufficient observation to arrive at solid observations. There is, however, some evidence of heterogeneity in the panel under investigation. In order to develop a better understanding of such heterogeneity, the possibility to identify subgroups within the total manufacturing sectors according to clearly identifiable a priori criteria was pursued. This allowed us to establish whether the coefficients on the respective investment functions for such groups are heterogeneous. One such classification identified Wage Goods, Resource Based Industries and Fabricated Manufacturing as clusters :Although the classification is open to debate they should be seen as a starting point for further discussion, rather than as a definitive clustering. A regrouping of clusters can easily be considered on the basis of cross sectional research that is currently undertaken in a parallel investigation on investment behaviour.

What emerges from the grouped manufacturing sector estimations is evidence of some strong sectoral differences. Of the three groupings of manufacturing sectors Wage Goods sectors are the most responsive to changing demand factors. By contrast, neither the Resource Intensive sectors, nor the Fabricated Goods sectors show a statistically significant response of the investment rate to a changing growth rate of capacity utilisation. Moreover, only the Fabricated Goods sectors shows a statistically significant response to changes in the user cost of capital. Finally, all three groupings are sensitive to uncertainty - indeed in this dimension the three sector groupings are the most homogeneous. The Resource Intensive sectors prove to be not only the most sensitive to the impact of uncertainty, but uncertainty seems to dominate all other determinants of the investment rate. Finally, we noted that the adjustment to equilibrium is of differential speed between the three clusters, with the Wage Goods sectors responding most slowly and the Resource Intensive sectors most quickly to policy interventions.

# Section 8: Policy Recommendations

It would be ambituous to suggest that a study of this nature can prescribe to policy makers what kind of policies they ought to pursue in order to boost investment in South Africa. The major objective of the report is to assist policy makers in defining the problems more clearly and provide some framework to understand what implications different policy levers may have. This section has two parts. A presentation of the key policy conclusions and some suggestions as to where future research needs to be focused on, to provide more concrete solutions to some of the issues raised.

### *8.1) Policy Implications*

*The role of Uncertainty and its Influence on the Threshold Rate of Return*

Uncertainty matters for investment, and it does so across all manufacturing sectors in the South African economy. This conclusion is maintained if we control for various definitions of uncertainty. The evidence presented in this study has consistently affirmed the importance of uncertainty in determining the investment rate in South African manufacturing. This emphasises not only the importance of adjustment costs as determinants of investment expenditure, but also that uncertainty raises the threshold rate of return below which investment is unlikely to occur.

It implies that any policy intervention designed to stimulate investment expenditure may face serious constraints in the sense that it may appear ineffectual, due to the influence of the relatively high threshold below which investment is simply not triggered. Where an industry is operating below the threshold rate of return on investment, policy intervention may be in fact altering the rate of return on investment and hence the incentive to invest, but may not trigger a physical investment response because the intervention has not been substantial enough to breach the threshold. For example, tax incentives or a reduction in the corporate tax rate can make investment more profitable but if uncertainty persists, the policy intervention has to be more significant to make a difference. A more substantial tax incentive to reduction in corporate tax rate is then needed.

Creation of a macroeconomic as well as microeconomic environment that is stable, predictable and devoid of sudden and arbitrary intervention is an immediate policy goal that emerges from the present study, not only because uncertainty has a direct negative impact on investment rates in manufacturing, but also because it serves to lower the threshold below which investment does not occur. In effect lowering uncertainty carries both a direct positive stimulus to investment, and it serves to render other policy levers more effective in achieving their objective.

*The Differential Impact of the User Cost of Capital*

Not surprisingly, the changes in the real user cost of capital critically influence the investment rate of manufacturing sectors. Changes in the component cost elements (the real expected interest rate, depreciation rate and the corporate tax rate) can influence the investment rate but magnitude of changes will depend on the

uncertainty environment. Where government is able to influence the inflation rate, interest rate, and corporate tax and provide a positive business environment, the user cost correlation may persist due to the significance of uncertainty in the investment behaviour in South Africa.

The impact of the user cost of capital proved to be strongest for the Fabricated Goods manufacturing sectors, and of more limited impact on the Wage Goods and Resource Intensive Goods sectors. Some sectors are more sensitive to the user cost of capital.

*The Role of Demand*

Changing demand conditions, proxying for the expected payoff to investment activity, are also seen to influence investment rates. Such an impact is found to be strongest on Wage Goods, while evidence of a demand impact on Resource Intensive and Fabricated Goods sectors is weaker.

*The Role of Trade*

Investment incentives may be boosted by a more open trade regime. Firms that become more export oriented will rely less on domestic markets and this can boost economic growth. On the other hand, local producers may find their margins under pressure with less tariff protection. At this stage our results are inconclusive in that they show that trade does not appear to exert a negative influence on investment rates thus openness of the economy is unlikely to be a deterrent to healthy investment rates

*Are Labour Costs a Deterrent to Investment?*

There is a general view that factor costs are often a major deterrent to investment. By factors we refer to capital and labour and their costs, the interest rate and wage rate respectively. In the case of the latter, the report shows that the impact of changes in real labour cost were found to be insignificant as determinants of the investment rate in fixed capital stock. They do, however, elsewhere it was shown that real labour costs can be important as determinants of labour usage (see Fedderke, Henderson, Kayemba, Mariotti & Vaze, *1999b*).

*Skills*

The impact of higher skills ratios on investment rates should be seen in the context of South Africa's dire track record in human capital production. As the severe skills shortages of the South African economy come to be ameliorated, such an impact may change from that found for the 1970-97 period.

*FDI versus Domestic Investment*

FDI constitutes a small part of total domestic investment in South Africa. Current figures estimate this to be about 8% of total domestic investment. Even this is an overestimation as it includes equity shares acquired by foreign investors. This kind of FDI may not contribute to an expansion of capital stock. In many ways foreign investment behaviour does not differ from domestic investment behaviour and government's efforts are best directed at focussing on factors that make the return on domestic investment more profitable.

**8.2)** ***Suggestions for Further Research***

Finally, we note a number of areas where further research can be undertaken.

*Continued Attempts to Improve Data for Better Policy Analysis*

Within the current set-up of the estimation framework a regrouping of clusters of sectors can easily be considered on the basis of cross sectional research that is currently undertaken in a parallel investigation on investment behaviour. The results of the panel data estimation for the regrouped clusters would then allow for a closer comparison with and benchmarking of the cross-section analysis. We have noted that the estimation results at the single sector level do not contain sufficient statistical power and should be interpreted with caution. For that reason, we presented those results without much analysis.

One way to improve statistical power is to increase the frequency of the time series by using quarterly data in stead of annual data. A first glance at the Stats SA data sources suggest that some of the necessary ingredients are available for a considerable period. Variables include gross and net value of production, capacity utilisation, production prices, employment and remuneration and even capital expenditure. The latter is published by Stats SA (P3042.3) on a quarterly basis back to 1991 with a possibility of additional prior years. Considerable spade work is, however, necessary to reclassify sectors to the latest 5$^{th}$ SIC framework from earlier SIC editions.

It was also noted that work on FDI is severely limited because of lack of proper time-series data. There are major inconsistencies amongst different data sets, and there are real problems in the way data is collected. Serious efforts needs to be put improving data on FDI.

*Aiming for More Systematic Links Between the Trading Regime and Investment*

The estimation results have so far indicated that the impact of trade policy on investment behaviour is limited. These results are based on the trade openness variables (defined here as the ratio of net trade to total trade). A number of other variables can be considered such as the import penetration ratio, the export penetration ratio and nominal and effective rates of protection. The latter, requires an estimate of nominal rates of protection and the structure of production, as embodied in an input-output table, going back to 1970. Although input-output tables are available from Stats SA only for selected years over this period (see Appendix 3B) a reasonable starting point would be to assume that the structure of production is fixed for the interim years. What is more important and without a doubt a bigger challenge is to obtain nominal tariffs for each year going back to the early 1970s. The only published data that is currently available can be found in Kuhn & Jansen (1997) and Fedderke & Vaze (1999)

*The Role of the Capital Market and Financial Intermediation*

In our econometric estimations credit rationing is used as one of the explanatory variables of investment behaviour. It was mentioned in section 5 that the presence of credit rationing in financial markets may drive a wedge between the cost of internal and the cost of external finance. We then carried out some testing of whether financial constraints are likely to have been of significance in South African manufacturing industry by

controlling for the magnitude of internal funds potentially available to industries – using the real gross operating surplus for this purpose.

Although the report did not offer profound reasons it was suggested that a change in allocation of capital across sectors in the South African economy is possibly linked to less distortions in the capital market. Clearly this is an area that requires more work - the nature of the capital market - how has it changed both in terms of the changing terrain of financial intermediation and monetary policy, selective interest incentives etc.

It makes therefore sense to try and employ sectoral data on cash flow directly together with other financial data at the sectoral level to explore the question of credit constrants more rigorously. Financial data is currently only available in published format at the macro level from the SARB. However, Bell *et al*. (1999) have employed company level data from McGregor-BFA in order to explore the link between finance and international competitiveness. McGregor-BFA cover JSE listed companies plus the top 500 non-listed companies in South Africa with respect to a number of financial variables. Moreover, companies are coded according to the 5$^{th}$ edition of the SIC. At first glance, it would appear that a least for some of the individual sectors and clusters of the manufacturing sectors if not manufacturing as a whole a reasonably representative sample can be established.

*Developing More Appropriate and Sector Specific User Cost of Capital Indices*

The user costs of capital variable employed in the estimation consists of an aggregate of three components, i.e., the interest rate, allowance depreciation and corporate tax. The first and the last component are homogeneous across sector and it will be difficult for control for at the sectoral level, especially the interest rate. It may however be possible to bring in a degree of sectoral variation with regard to the corporate tax rates if one were to investigate the various tax exemption schemes that have been in operation in South Africa over the period of observation. Clearly, some ad-hoc judgement call will have to be made along the line but in principle such an exercise is not impossible. For example, the Tax Holiday Scheme was *not* available to certain sectors such as Basic Iron & Steel. Alternatively, it may be possible to estimate actual tax rates from Stats SA's financial series on manufacturing (P3042.1) or from the McGregor-BFA source mentioned above.

Our descriptive analysis in Section 4 has hinted at possible capital market distortions in South Africa. However, we have not been able to control for capital market distortions in an explicit way. One way to do this is to look for differential access to capital across sectors. One means of addressing this question is to unbundle the user cost of capital variable more rigorously than was feasible for the present report. Another may be to examine more closely the productivity of capital more closely – a suggestion that is pursued under the following point.

*Growth, Efficiency and Investment*

Where capital resources have been inappropriately applied, we might expect a poor relationship between the growth in output and the growth in the capital factor of production. Where distortions in the capital market lead to a misallocation of capital to unproductive use, standard decompositions of the growth in total output into the proportion attributable to capital, to labour and to total factor productivity, should show a small proportion of

the growth attributable to capital. Instead of examining the misallocation of capital on the *inputs* side, therefore, it makes sense to examine the misallocation of capital by observing the *realised* productivity of capital. The advantage of the approach would be that one is able to obtain not only an historical perspective, but that the monitoring could be updated on a continuous basis.

*Sector Specific Uncertainty*

Although we have undertaken some sensitivity analysis around the uncertainty variable (see footnote 40), the main index and its labour unrest variations apply equally across all sectors. Thus, sector specific uncertainty is currently ignored. This may be an undeservedly abstraction of the economic reality for certain sectors. One possible way of introducing such uncertainty in the analytical framework is to employ sales price volatility as a proxy. This extension can easily be accommodated by our data base since it contains gross value of production, i.e., sales, in constant and current prices, so that price volatility can then be derived from the ratio of the two variables.

# References

Abel, A. (1983): Optimal Investment Under Uncertainty, *The American Economic Review*, 73(1), : 228-233.

Abel, AB & Blanchard, OJ. (1988): The Present Value of Profits and Cyclical Movements in Investment, *Econometrica*, 54(2): 249-73.

Abel, B & Eberly, JC. (1994): A Unified Model of Investment Under Uncertainty, *The American Economic Review*, 84(5): 1369-1384.

Adelzadeh, A. (1996): From RDP to GEAR: the Gradual Embracing of Neo-Liberalism in Economic Policy, *Transformation*, 31: 66-95.

Baldwin, RE & Seghezza, E. (1996): *Testing for Trade-Induced Investment-Led Growth*, CEPR Discussion Paper No. 1331.

Bell, T, Farrell, G & Cassim, R. (1999): *Competitiveness, International Trade and Finance in a Minerals-rich Economy: The Case of South Africa*, mimeo.

Bernake, BS. (1983): Irreversibility, Uncertainty and Cyclical Investment, *Quarterly Journal of Economics*, 98(February): 85-106.

Bisat, A, El-Erian, MA & Hebling T. (1997): Growth, Investment and Saving in the Arab Economies, *International Monetary Fund Working Paper* 97/85.

Chan-Lau, JA & Clark, PB. (1998): Fixed Investment and Capital Flows: A Real Options Approach, *International Monetary Fund Working Paper* 98/125.

Chen, Z & Khan, MS. (1997): *Patterns of Capital Flows to Emerging Markets: A Theoretical Perspective*, International Monetary Fund Working Paper 97/13.

Collier, P & Gunning, JW. (1999): Explaining African Economic Performance, *Journal of Economic Lieterature*, 37(1).

De Mello Jr, L. (1997): Foreign Direct Investment in Developing Countries and Growth: A Selected Survey, *Journal of Development Studies*, 34(1): 1-34.

Dixit, AK & Pindyck, RS. (1994): *Investment under Uncertainty*, Princeton: University Press.

Edwards, C. (1998): Financing Faster Growth in South Africa: The Case for Reforming the Financial Sector, *Transformation*, 35: 49-76.

Eisner, R & Strotz, RH. (1963) *Determinants of Business Investment, in Impacts of Monetary Policy*, A Series of Research Studies Prepared for the Commission on Money and Credit, Prentice-Hall, Englewood Cliffs, NJ, 60-233.

Engle, RF, Lilien, DM & Robins, RP. (1987): Estimating Time Varying Risk Premia in the Term Structure: the ARCH-H model, *Econometrica*, 55: 391-405.

Fazzari, SM, Hubbard, RG & Peterson, BC. (1988a): Financing Constraints and Corporate Investment, *Brookings Papers on Economic Activity*, 1: 141-195.

Fazzari, SM, Hubbard, RG & Peterson, BC. (1988b) Investment, Financing Decisions and Tax Policy, *The American Economic Review*, 78(2): 200-205.

Fedderke, JW. (2000): *Investment in Fixed Capital Stock: the South African Manufacturing Industry 1970-97*, Report prepared for the Trade and Industry Policy Secretariat, Econometric Research Southern Africa Working Paper No 16, University of the Witwatersrand.

Fedderke, JW, De Kadt, RHJ & Luiz, JM. (1999a): *Indicators of Political Liberty, Property Rights, and Political Instability in South Africa: 1935-97*, International Review of Law and Economics, forthcoming, Working Paper No7, Econometric Research Southern Africa, University of the Witwatersrand.

Fedderke, JW, De Kadt, RHJ & Luiz, JM. (1999b): *Production of Educational output: Time Series Evidence from Socio-Economically Heterogeneous Populations - the Case of South Africa 1910-93*, Econometric Research Southern Africa Working Paper No7, University of the Witwatersrand.

Fedderke, JW, De Kadt, RHJ & Luiz, JM. (1999c): *Growth and Institutions*, Econometric Research Southern Africa Working Paper No6, University of the Witwatersrand.

Fedderke, JW, de Kadt, RHJ & Luiz, JM. (2000a): *Uneducating South Africa: The Failure to Address the Need for Human Capital*, International Review of Education (UNESCO), Forthcoming, Econometric Research Southern Africa Working Paper No2, University of the Witwatersrand.

Fedderke, JW, de Kadt, RHJ & Luiz, JM. (2000b): *A Capstone Tertiary Educational System: Inefficiency, Duplication and Inequity in South Africa's Tertiary Education System, 1910-93*, Econometric Research Southern Africa Working Paper No14, University of the Witwatersrand.

Fedderke, JW, Henderson, S, Kayemba, J., Mariotti, M & Vaze, P. (1999a): *Changing Factor Market Conditions in South Africa: The Labour Market - A Sectoral Description of the Period 1970-1997*, Report prepared for the South African Department of Finance, Econometric Research Southern Africa Policy Paper No.4, University of the Witwatersrand.

Fedderke, JW, Henderson, S, Kayemba, J., Mariotti, M & Vaze, P. (1999b): *Changing Factor Market Conditions in South Africa: The Capital Market - A Sectoral Description of the Period 1970-1997*, Report prepared for the Trade and Industry Policy Secretariat, Econometric Research Southern Africa Policy Paper No.5, University of the Witwatersrand.

Fedderke, JW & Liu, W. (1998): *South African Capital Flows and Capital Flight Over the 1965-95 Period*, mimeo.

Fedderke, JW & Vaze, P. (1999): *The Nature of South Africa's Trade Patterns by Economic Sector, and the Extent of Trade Liberalization during the Course of the 1990's*, Econometric Research Southern Africa, University of the Witwatersrand.

Fedderke, JW, Shin Y & Vaze, P. (1999): Trade and Labour Usage: *An Examination of the South African Manufacturing Industry*, Report for South African Department of Finance, Econometric Research Southern Africa Working Paper No 15, University of the Witwatersrand.

Ferderer, JP. (1993): The Impact of Uncertainty on Aggregate Investment Spending: An Empirical Analysis, *Journal of Money, Credit and Banking*, 25(1): 49–61.

Feldstein, M & Horioka, C. (1980): Domestic Saving and International Capital Flows, *The Economic Journal*, 90(June): 314-329.

Fielding, D. (1997) Aggregate Investment in South Africa: A Model with Implications for Political Reform, *Oxford Bulletin of Economics and Statistics*, 59(3): 349-369.

Fielding, D. (1999): *Manufacturing Investment in South Africa: A Time Series Model*, Unpublished manuscript, University of Notttingham

Gilchrist, S & Himmelberg, C. (1998): *Investment, Fundamentals and Finance*, NBER Working Paper No W6652.

Guiso, L & Parigi, G. (1999): Investment and Demand Uncertainty, *Quarterly Journal of Economics*, 114(1): 118-227.

Hartman, R. (1972): The Effects of Price and Cost Uncertainty on Investment, *Journal of Economic Theory*, 5: 258-66.

Hayashi, F. (1982): Tobin's Marginal *q* and Average *q:* a Neoclassical Interpretation, *Econometrica*, 50(1): 213-24.

Heese, K. (1999): *Foreign Direct Investment in South Africa (1994 - 1999) - Confronting Globalisation*, TIPS Annual Forum, Muldersdrift.

Hubbard, RG. (1998): Capital Market Imperfections and Investment, *Journal of Economic Literature*, 36(March): 193-225.

Johnson, OEG. (1997): Policy Reform, Adjustment Costs and Investment: With Activity of Local Investors as a Signal, *International Monetary Fund Working Paper* 97/148.

Jorgenson, DW. (1963): Capital Theory and Investment Behaviour, *The American Economic Review* (Papers and Proceedings), 53(2): 247-259.

Jorgenson, DW and Siebert, CD. (1968): A Comparison of Alternative Theories of Corporate Investment Behavior, *American Economic Review*, 58(4): 681-712.

Khan, MS. & Kumar, MS. (1997): Public and Private Investment and the Growth Process in Developing Countries, *Oxford Bulletin of Economics and Statistics*, 59(1): 69-88.

Kok, WJ. (1981): *Die Kapitaal Struktuur van die SA Fabriekswese*, Unpublished PhD Rand Afrikaans University.

Kuhn G, Jansen, R. (1997): *The Effective Protection Rate and Anti Export Bias*, IDC Technical Paper Series, TS1/97.

Levine, R & Renelt, D. (1992): A Sensitivity Analysis of Cross-Country Growth Regressions, *The American Economic Review*, 82(4): 942-963.

Levine, R & Zervos S. (1998): Stock Market, Banks and Economic Growth, *The American Economic Review*, 88(3): 537-558.

Mbekeani, KM. (1997): *Foreign Direct Investment and Economic Growth*, TIPS working paper.

Mohr,PJ, Botha, ZC, Inggs, EJ & van der Merwe, CM. (1988): *The Practical Guide to South African Economic Indicators*, Lexicon.

Odedokun, MO. (1992): An Alternative Framework of Estimating Investment and Saving Functions for Developing Countries: An Application to Time Series Data for Sub-Saharan African Countries, *International Economic Journal*. 6(3): 49-73.

Pagan, A & Ullah, A. (1988): The Economic Analysis of Models with Risk Terms, *Journal of Applied Econometrics*, 3: 87-105.

Pastor Jr, M & Hilt, E. (1993): Private Investment and Democracy in Latin America, *World Development*, 21(4): 489-507.

Pesaran, MH. (1997): The Role of Economic Theory in Modelling the Long Run, *Economic Journal*, 107: 178-91.

Pesaran, MH & Smith, RP. (1995): Estimating Long-Run Relationships from Dynamic Heterogeneous Panels, *Journal of Econometrics*, 68: 79-113.

Poirson, H. (1998): Economic Security, Private Investment and Growth in Developing Countries, *International Monetary Fund Working Paper* 98/4.

Pretorius, CJ. (1998): *Gross Fixed Investment in the Macro-Econometric Model of the Reserve Bank*, South African Reserve Bank.

Price, S. (1995): *Aggregate Uncertainty, Investment and Asymmetric Adjustment in the UK Manufacturing Sector,* Unpublished manuscript, City University London.

Rajan, RG. & Zingales, L. (1998): Financial Dependence and Growth, *American Economic Review*, 88(3), pp. 559-586.

Rama, M. (1993): Empirical Investment Equations for Developing Countries, in Serven L & Solimano, A (eds) *Striving for Growth after Adjustment: the Role of Capital Formation*, World Bank, Washington DC.

Razin, A, Sadka, E & Chi-Wa Yuen. (1998): A Pecking Order to Capital Inflows and International Tax Prinicples, *Journal of International Economics*, 44: 45-68.

Romer, D. (1996): *Advanced Macroeconomics*. McGraw-Hill, New York.

Serven, L. (1996): *Irreversibility, Uncertainty and Private Investment: Analytical Issues and Some Lessons for Africa*, preliminary paper AERC Research Workshop.

Serven, L & Solimano, A. (1993): Private Investment and Macroeconomic Adjustment: a Survey, in Serven L & Solimano, A (eds) *Striving for Growth after Adjustment: the Role of Capital Formation*, World Bank, Washington DC.

Summers, LH. (1985): Tax Policies and International Competitiveness, *International Aspects of Fiscal Policy*, J. Frenkel, ed. Chicago: University of Chicago Press.

Tobin, J. (1969): A General Equilibrium Approach to Monetary Theory, *Journal of Money, Credit and Banking*, 1(1): 15-29.

Vamvakidis, A. (1998): Explaining Investment in the WAEMU, *International Monetary Fund Working Paper* 98/99.

Vamvakidis, A & Wacziarg, R. (1998): Developing Countries and the Feldstein-Horiaka Puzzle, *International Monetary Fund Working Paper* 98/2.

Van der Walt, J and De Wet, G. (1995): *The Prospects for Foreign Investment in South Africa*, University of Pretoria.